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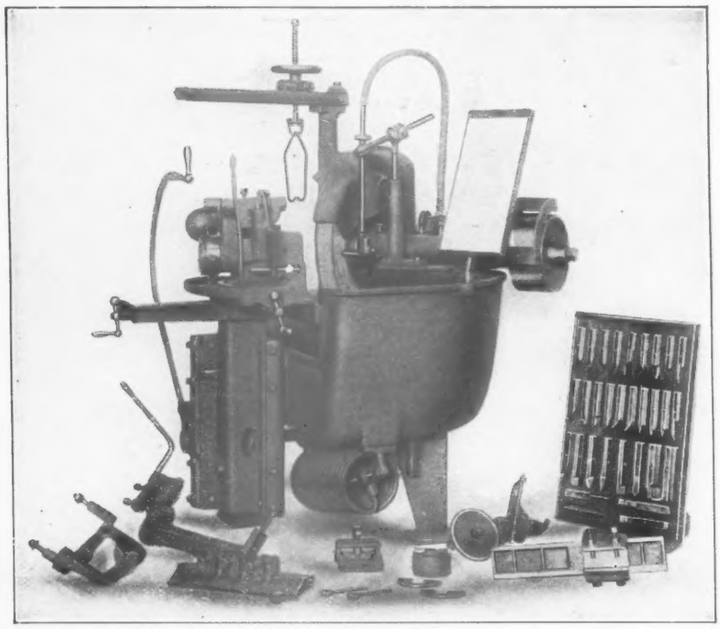

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Railway Mechanical Engineer

Volume 91 September, 1917 No. 9

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The Mechanical Department and the War

Do the mechanical department forces realize the part they are playing in the world war for democracy? Do they understand that by their work, indirectly of course, they may be the means of saving the lives of thousands of American soldiers? Daniel Willard, president of the Baltimore & Ohio and chairman of the Advisory Commission on National Defense, in an address to the officers of the Baltimore & Ohio, an abstract of which is published elsewhere in this issue, shows with exceptional clearness the part railway mechanical department men must play in this war. This country must supply munitions, food, ships and equipment to our Allies. The traffic offered to American railways has assumed such proportions that some of it cannot be carried and it is expected that conditions will be still worse in the months to come. We must meet these extreme conditions without the full aid of car and locomotive builders since a large proportion of their output must be turned over to the government for use in France and to our Allies. This means that every ounce of power and every particle of service must be obtained from the equipment now in service. Cars must be made to carry heavier loads and locomotives must be made to haul heavier trains. Everything should be loaded to its full capacity and made to produce the greatest amount of work.

Russia is badly in need of locomotives. Today 25 per cent of its power is out of commission for lack of material and labor; meanwhile the demands on its railway equipment have been tremendously increased. With its coal supply from England cut off, it must transport coal from the Caucasus, which is 1,400 miles from Petrograd. The Russian railroads are handling 1,500 cars of coal over this line each day. This absorbs a large proportion of the equipment. This country must furnish the much needed additional equipment and American railroads must get along as best they can with their present equipment. The success of the Russian campaign is dependent upon transportation facilities. If it fails and Russia makes a separate peace with Germany, the 2,000,000 or more Germans on the eastern front will be released for service on the western front and this means that just so many more American boys must go to France to win the fight, for win we must! Improving the existing equipment and making it do its full duty is the "bit" our railway forces are called upon to perform.

A Responsibility of Officers and Foremen

Those in charge of railway shops, engine houses and car repair yards often overlook one of their greatest responsibilities. Output and quality of workmanship are concrete things which are aimed at, involving numberless details, and in securing them only the roughest sort of attention has been given by most railroads to the training of the men in their various duties. Little, if any, attention has been given to teaching them to become better citizens. In times of peace and prosperity the neglect of this important duty on the part of foremen and supervising officers, although it may be noticeable, does not become as apparent as in time of war. Today, when every workman must give the very best that he has in order

to win the war, a proper understanding of his responsibilities to his country and his patriotic privileges and duties is a matter of prime importance. There is no limit to what this country can accomplish if its people generally will fully awaken to the seriousness of the present situation and the part that they can play as individuals in bringing the war to a successful conclusion. Every foreman or officer in charge of groups of men, large or small, should do his part in helping to make them good citizens by making sure that they fully understand the duties and privileges of American citizens and the importance of each individual putting forth his best efforts, whether it be in the army, in an industrial establishment, helping in the great work of transportation, or otherwise increasing production or conserving energy and material.

Axle Generator Location on Passenger Cars

Not enough attention is given to the proper arrangement and location of the axle lighting generator and axle pulley on passenger cars. Too often the car designer disregards this equipment and leaves the electrical engineer to apply it as best he may. The greatest source of trouble with the axle lighting system is the belt, and this is not always the fault of the belt itself, but because it has been impossible to locate the generator and axle pulley so that satisfactory service will be obtained. To insure the best service from the belt the axle pulley should be about 20 in. diameter, and have a face of 10 in. The pulley should be mounted near the center of the axle, especially with body mounted generators, so that the belt distortion on curves will be reduced to a minimum. It has seldom been found possible to do this because of obstructions on the truck, although if proper thought had been given in designing the truck these could in most cases have been easily eliminated. The electric lighting equipment on passenger cars is common at the present time and unless there is the proper co-operation between the mechanical and electrical departments, the maintenance of this equipment will prove a troublesome and expensive problem. Several standards have been accepted by both the Master Car Builders' Association and the Association of Railway Electrical Engineers which have been found to work out very satisfactorily. Up to the present time, however, it has been found necessary to allow too much variation in the dimensions of pulley diameters and faces, simply because it has been impossible to control the design of the truck so that the best arrangement could be used.

Handling Locomotives at Terminals

In order to disseminate all the information possible concerning efficient handling of locomotives at terminals, the *Railway Mechanical Engineer* will pay a first prize of $35, a second prize of $25 and a third prize of $15 for the three best articles telling how the time taken to turn a locomotive at a terminal may be reduced. Our purpose of running this competition at the present time following so closely the competition on the Engine House Terminal of a little over a year ago, is to be sure that all possible information on this subject is laid before our readers to help them meet the serious situation with which they will be confronted during the coming winter. Our railroads need power badly. With about one-half the output of our locomotive builders dedicated to the Allies, the railroads can not receive their full support. We must make the best use of the power we have. Tell us how you have reduced the time your locomotives have been held at terminals so that everybody may profit from your experience. The subject is broad. Results are what we want, with an explanation of how they were obtained. Tell us so that we may tell others.

The competition will close Monday, October 22, at our New York office in the Woolworth building. It is an odd date for closing a competition, but we want to give you all the time possible to write your article and still not have it too late for the coming winter. Some of the prize winning articles will be published in the November issue. Let us hear from every one who has any information on the subject. Those articles that are not awarded prizes which are published will be paid for at our regular space rates.

Remember the closing date—October 22.

Women Workers In Railroad Shops

Railroad shops and car repair yards have been seriously handicapped by the shortage of labor during the past two years, and this is particularly true in industrial sections of the country. Labor conditions instead of growing better are steadily getting worse; meanwhile the heavy stress under which the railroads have been laboring is beginning to tell on the condition of the equipment. It will be necessary, however, to handle more business than ever during the fall months and through the winter.

Several roads, in the emergency, are turning to the more extensive use of women. The complications that may arise by rushing into this thoughtlessly are so great that a word of caution is necessary at this time. Many roads have large numbers of boys and men doing office work that can be performed satisfactorily by girls and women. This will allow the men to be transferred to more active work for which they are better fitted and where in many cases there will be a greater opportunity for advancement than if they remained in the offices. Logically then, the women should first be used to replace the men in positions of this kind.

When it comes to doing heavy physical work in the shops, engine houses or repair yards it will be wise to go slowly. Conditions should be studied critically and not a woman should be started on the work until the conditions are right and the rules and regulations under which they will work are thoroughly outlined and understood. Suitable retirement rooms should be conveniently located and shop matrons or forewomen should be provided. Rigid discipline as to conduct should be established from the very start and carelessness on the part of either sex in relation to the other should not be tolerated for a moment. So far as possible the women should be worked in groups and be segregated from the men. At the Grand Trunk shops at Montreal several women were started to work at one time and a woman who had worked in English shops was placed in charge in order to instruct and coach them.

Too much care cannot be taken to thoroughly instruct the new employees in their duties, and this applies to both men and women. Railroad shops have never been noted for having sufficient supervision; under the peculiar conditions which exist at present it will be impossible for overworked foremen to give the new employees the attention they need to become efficient workmen. In many shops it will be necessary to take radical steps to secure the necessary amount of supervision. Failure to do this will spell disaster. It will effect not only the men in charge, but the entire railroad, our whole country, the boys at the front, and the cause of liberty and democracy. For years we have begged the railroads to install adequate apprentice systems. The number that have done so is pitifully small. Had they all done so —or even a majority of them—the mechanical departments would be in a very different condition today. Intensive methods must immediately be taken to instruct the new employees and see that they not only understand how to do the work in the best way, but that they actually live up to the instructions. This is no small task.

First aid classes should be started for the women so that they may take proper care of any of their number that may be injured without calling on the men. The women must be paid on the same basis as the men. If possible, arrange-

ments should be made so that they will lunch in a group by themselves; facilities can well be provided so that they can make hot tea or coffee. Skirts and flimsy clothing are dangerous in many cases and should be discarded for loose fitting jumpers specially designed for the women. These are a few of many factors that must be considered before the women can be introduced successfully into railroad shops.

An Opportunity for the Mechanical Engineer

Railroad mechanical engineers have a splendid chance to be of service to the roads and to the nation if they will realize the part they can play in increasing the efficiency of the transportation system at this time. All records for traffic handled are being broken this year. While 1916 set new records, the ton-miles hauled in 1917 are much greater than last year. More locomotives and cars are required than ever before and shops are working to the limit of their capacity. New conditions have arisen which require new methods of handling work. Under ordinary circumstances the process of adjustment would be a gradual one, but now we must secure the maximum efficiency at once. The railroads have been modernizing their locomotives during the past few years, but even so it will be difficult to meet the demands for power this winter. While much has been done to make old cars fit for heavy service, there is still a large field for such work. Old equipment must be made serviceable, yet steel should be eliminated from the design wherever possible. The problem is one which calls for all the ingenuity of American railroad men.

Unfortunately most of the officers of the mechanical departments are so busy with their regular duties that they have little time to devote to these important problems. Perhaps the one notable exception is the mechanical engineer. Little new equipment is being bought and he is therefore relieved of the work of designing and drawing up specifications, which forms a considerable part of his regular duties. There is therefore a splendid opportunity for the mechanical engineer to take a leading part in the work of developing methods of increasing the service secured from locomotives and cars. Any measures that will decrease the time that locomotives and cars are under repairs will in effect add to the equipment of the railroads, an object for which all must strive at this time. Any means of shortening the time required to do a given job, either by redesigning of parts or by the development of new methods of doing work, will in effect add men to the railroads' and to the nation's forces. No man is better qualified to undertake the solution of such problems than the mechanical engineer. Let him do his part in this crisis by seeing that as far as it lies in his power the railroads make the best possible use of their men and of their materials in order that, in the words of President Wilson, "these arteries of the nation's life suffer no obstruction, no inefficiency or slackened power."

The Value of Shop Schedule

This journal has for many years consistently advocated the importance of introducing shop scheduling systems into locomotive repair shops as a means of cutting out lost motion and toning up the organization, thus increasing the output. Unfortunately comparatively few managements have made any very serious attempts to install such schedules. Just why this is so it is difficult to understand, for such systems are comparatively simple. True, they must have the backing of the higher mechanical department officers and they must be administered with a reasonable amount of intelligence and common sense. Something is wrong, however, with any railroad that will intrust its repair shops to men who do not possess such qualities.

The real reason is doubtless a mental inertia or indifference caused by the fact that too many shop superintendents and foremen allow themselves to be swamped with a mass of details that might far better be shifted to the shoulders of their subordinates. Just how to jar—and this word is used advisedly—such men into a larger appreciation of their responsibilities and opportunities is a problem; some of them may be so constituted that they will never awaken. It might help some if the head of the mehcanical department would call upon them for detail reasons as to why they had not installed such schedules. It might be extremely helpful, also, if some of the higher officers would ask themselves why they had not insisted on the installation of schedules.

Conditions at present are such that the necessity of installing real shop schedules—no milk and water variety—and of otherwise improving the efficiency of the organization, is more vital than ever. The shortage of labor and the inability of the railroads in some districts to compete with the high wages offered by manufacturing industries, thus losing a considerable number of their skilled workers, has developed and thrown into glaring relief the weak spots in the supervision and the necessity for following up the various operations more closely. In shops which have installed and religiously lived up to the shop schedules weak spots have been automatically located. It has been said that the systematization of the work made necessary by the introduction of the scheduling system and the strengthening and upbuilding of the weak spots thus developed will make possible an increase of ten per cent in the output of the average shop. For purely patriotic reasons, if for no other, such an opportunity should not be indifferently passed by in the present emergency. This is no time for slackers.

The Future of the Mechanical Department

"It is recognized in England that it is the locomotive rather than the rail that has made railroads of such importance as arteries of traffic. The chief mechanical engineer, as the superintendent of motive power is termed, is therefore given a rank, consideration and authority, which he does not have in the United States." This quotation is taken from "Some European Railway Practices," by H. W. Jacobs, the observations having been made in 1912.

In December, 1903, George M. Basford, at that time visiting England, wrote: "They (English locomotive superintendents) all talk as if the entire responsibility of their departments rested entirely upon them, and as a matter of fact it does. In a large sense, they have autocratic powers and as a rule, while subordinate to their general managers, they deal with the directors themselves, and thus play an important part in the policy of the railroad; usually the larger motive power questions are dealt with by a committee of the directors, who hold fortnightly meetings, with the highest official of the road, the chairman, presiding. The general manager of the road may or may not attend. I am told that he usually does not, unless questions of operation are involved. This brings the motive power department into a prominence which it has not attained with us. In fact, it seems that English stockholders look upon this as the most important department and the one from which most is expected. The officer in charge of it is therefore much in the public eye and is high in the councils of railroad men. . . . The authority of the locomotive superintendent seems to be far beyond the reach of the stockholders when questions of safety and proper working condition of equipment are concerned. No president or general manager here buys locomotives or cars without consulting the head of the mechanical department. He would not dare take such responsibility."

It has remained for Canada, our neighbor to the north, to snatch from us the honor of being first to elevate and dignify the work of the mechanical department on this continent. W. D. Robb, superintendent motive power of the Grand Trunk, has just been made vice-president of that

road in charge of motive power, cars and machinery. Doubtless the chairman of the board, A. W. Smithers, who has his home in London, but has been in Canada for several months, had the English system in mind when Mr. Robb was made vice-president. Doubtless also, Mr. Robb will have authority commensurate with his new title.

It is unfortunate that American roads have given so little attention to the needs of the mechanical department and have generally so greatly underestimated its importance and the necessity of giving the head of the department the authority which he really should have in the interests of efficiency and economy. Mechanical department officers are not above making mistakes, but they could barely have worse consequences than the hand-to-mouth maintenance policy which has been followed on many roads at the direction of those in authority. Nor if they were given full responsibility for designing and ordering equipment would they be found rushing designs through at the last minute and leaving details to the builders. Nor would there have been so little study of the adaptability of different types of cars and locomotives.

Mechanical department officers have fallen short of what they should be and doubtless have not measured up to their full opportunities, but they have not had the best sort of soil to grow in and have had little or no cultivation. Today is their real opportunity. If they can somehow manage to keep the equipment in shape to pull through the heavy traffic of the fall and winter and deliver the goods to our armies and our allies then they will have clearly qualified for bigger things in the railway organization and Mr. Robb will not stand alone with his new title and broader duties and responsibilities. It is a superhuman task. Let us hope it will surely be accomplished.

NEW BOOKS

The Founder's Manual. By David W. Payne. Bound in leather, 676 pages, 4½ in. by 7¾ in. Published by D. Van Nostrand Company, 25 Park Place, New York. Price $4.00 net.

In his preface the author states that while there is little a foundryman needs to know which has not been fully treated by competent authorities, there is no summary of this great mass of publications. The author's purpose, therefore, has been to bring together in one volume, where it may readily be located, a fund of information dealing with all phases of foundry work, making the volume in effect, a foundryman's handbook. In an effort to make the book of value to the novice, however, many pages of descriptive matter dealing with foundry equipment and practice have been added which will be of little interest to the experienced foundryman.

The subject matter of the volume may roughly be divided into three classes. The first seven chapters are devoted to mathematics, mechanics and a miscellaneous collection of engineering data, which have been compiled from other authorities, including Trautwine, Kent and structural steel handbooks. Some of this information has little bearing upon foundry work in particular and probably will be of little use to the average reader. Chapters 8 to 17, inclusive, are devoted to the presentation of the properties of cast iron, giving specifications for various classes of castings and including information relative to the mixing and testing of irons. One of these chapters deals with the casting of steel in the foundry. The remaining ten chapters of the book cover the details of foundry practice, and include chapters on foundry fuels and molding sand. One chapter goes into the subject of foundry accounts in considerable detail. In general, the arrangement of the material in the book has been worked out logically, but the use of chapter subdivisions in what is essentially a handbook of reference, has led to a number of incongruities in the grouping of material in individual chapters. However, by using a topical index at the close of the book, no difficulty will be encountered in locating the material desired.

COMMUNICATIONS

IMPROVEMENT IN AIR BRAKES ON FREIGHT CARS

Charleston, S. C.

To the Editor:

Considerable improvement has been made in the percentage of good brakes on freight trains in the last six months, most of the shops now having one or more air brake inspectors and repairers that test the brake pipes, triples and retaining valves. It is the general practice for these men to test the pipes for leaks with soap-suds on the joints after charging them with air, and to apply the gage to the exhaust port of the triple to determine leakage while the brakes are applied. When necessary to repair triples and retaining valves this should be done in the shop, and not attempted by the men in the yard making the test. The improvement in the brake equipment is due largely to the improved maintenance of cylinder leathers and expander rings. This class of work is of the greatest importance and should be put into effect at all points where air plants are available for testing the brakes. In addition to efficiency being one of the Safety Appliance Acts, it is resulting in the saving of overtime money that has been paid to the engine and train crews, and the vast amount of fuel that would be used in dragging cars with brakes sticking.

J. S. Breyer.

MILLING JAWS IN SIDE RODS

Battle Creek, Mich.

To the Editor:

I have read with a great deal of interest the first prize article on locomotive rod repair work in the June issue and wish to congratulate Ernest A. Miller on the value of his article and the clear and explicit manner in which it is written.

The worth of such papers as his would be less if they did not succeed in bringing out some criticism or discussion. I, therefore, with the very best of intentions, wish to call attention to Mr. Miller's method of cutting out the forked end, or as he terms it, the knuckle pin connection of the side rod, which he first drills, then slots out. This should be milled out of the solid rod with a helical cutter, having a bearing on the outer end. I have seen a perfectly good job done with one cut 2⅛ in. wide by 10 in. long in an hour; a much better job I am sure than can be done on the slotter with the two cuts described. After the cutter has been reground, of course losing its original diameter, two cuts through would be necessary, the second or sizing cut only removing probably 1/32 in., where a very much coarser feed may be taken. I feel sure that by this method the whole end could be milled in but a very little longer time than it takes to set up and drill the rod and take it to the slotter and get a cut started there. Of course, I understand Mr. Miller may not have access to the kind of milling machine necessary for this work but such a machine should be included in a lay-out of machine tools for the rod job.

M. H. Westbrook.

Cost of Coal on Swiss Railways.—The quantity of coal used yearly by the Swiss Federal railways is as follows: In 1915, 636,298 short tons, or 33 pounds per kilometer of 0.621 miles; in 1916, 652,884 tons, or 34 pounds per kilometer. The average price per ton paid for coal by the Swiss Federal Railways during the past 5 years was as follows: In 1912, $5.27 per ton of 2,204 pounds; in 1913, $5.22; in 1914, $5.17; in 1915, $5.15; in 1916, $6.17.

DESIGN OF HEAVY HELICAL SPRINGS

A Study of Spring Deflection with Computations for Single and Nest Springs, and Illustrative Examples

BY G. S. CHILES AND R. G. KELLEY

I

SPRINGS are formed from rigid materials, usually metals, and are subjected to flexure and torsion. By bending a rod or bar around an arbor, and, at the same time, advancing it like the threads of a screw, what is known as an helical or coil spring, frequently erroneously called a spiral spring is formed. Compression springs are built with various types of ends, of which the following are examples (See Fig. 1): Plain ends, not ground, (A); plain ends, ground, (B); squared or closed ends, not ground, (C), and squared or closed ends, ground, (D). The ends of coil springs for railway service are usually tapered sufficiently to give a firm bearing and are closed as illustrated in Fig. 1 at *D*,

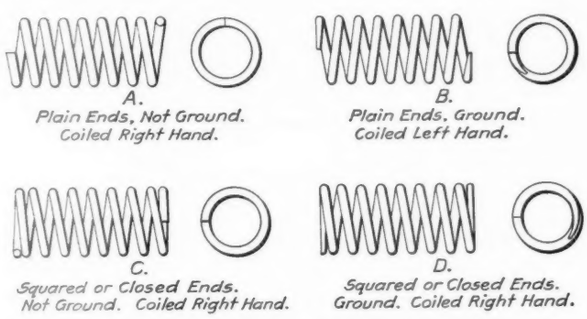


Fig. 1—Various Types of Compression Springs

although the distance that the ends remain in contact may vary to a greater or less extent.

While compression springs are made in many special shapes, and of bars of various sections, we will deal principally with round material as this is the material generally used in the manufacture of helical springs, which are to be used in "nests." By the term "nest" is meant a group of springs of varying diameters placed one within another to act as a single unit as shown in Fig. 2. In designing the different springs of a nest, each spring is computed separately, and one method which may be used in calculating such springs as well as in testing springs so designed will be described in detail below.

In order to prevent the tendency of the coils to bind, each alternate spring comprising the "nest" is wound in an opposite direction. It is common practice to leave 1/16 in. clearance all around between adjacent coils; that is, the inner diameter of the outer coil is made 1/8 in. greater than the outer diameter of the next inner coil. Sometimes the arbor upon which the bar is wound is tapered slightly, occasionally as much as 1/8 in. in diameter per foot of length, but usually not over 1/16 in. per foot. While this facilitates removing the spring from the arbor, and provides for the specified diameter of spring at the center of its length, it results in a slight decrease in the diameter at one end of the coil, and an equal increase in diameter at the other end of the coil.

There is no set rule in regard to the free and solid heights of the various coils; in many instances each coil is given the same solid height; in others, the free height is the same; while sometimes both the solid and free heights of all the coils may be the same. It is generally considered good practice to design springs built of heavy bars; i. e., above say 3/4 in. or 7/8 in. to compress solid at a fibre stress not to exceed 80,000 lb. per sq. in., while springs built of smaller bars may be stressed as high as 90,000 or 100,000 lb. per sq. in. Some designers exceed these values by as much as 10,000 lb., while others prefer values which are proportionately less. With common spring steel, such as is covered by the Pennsylvania Railroad specifications, the higher fibre stress may cause some springs to take a slight permanent set after they have been compressed solid a few times.

When designing railway springs it is customary to provide for a deflection of about 50 per cent of the difference between the free and solid height. Springs so designed would be subjected to a fibre stress, under the static load, of an amount equal to one-half the maximum stress when compressed solid. Under working conditions the deflection and corresponding fibre stress will vary; at times being less than one-half, and at other times equalling the maximum, since springs in service often indicate that the coils have frequently pressed upon each other with considerable pressure. Springs are intended to dissipate shocks and blows, but when they are compressed to such an extent that the coils are in actual contact the desired protection is no longer given, and such springs fail to fully serve the purpose for which they were designed. As is the case with many details of railway equipment, coil springs are intended to remain in service over a period of years, and this may be one of the reasons why springs are expected to sustain shocks or vibrations which will cause the coils to be compressed until they are in contact without taking any permanent

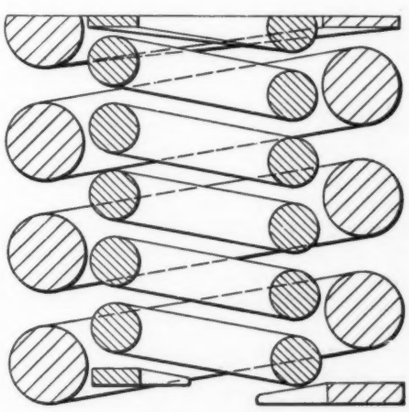


Fig. 2—Typical Nest Spring

set; another reason may be due to a desire to simplify testing. It is an open question as to whether or not this method of designing and testing springs always insures that such springs will not take a set or gradually lose height after a period of years, although, unless the service to which the spring is to be subjected is unusually severe, good results could reasonably be expected. But why not design the spring to act as the weakest part, and to break or, preferably, take a permanent set under an excessive shock rather than spare

it at the expense of having the coils come into contact with each other and, as a consequence, impose an additional strain upon some other more expensive or more important detail which the spring is intended to shield. Undoubtedly the designer should make such provision that there will be no possibility of the coils of truck springs coming into contact with each other in service, not only in order to insure long and continued service, but also, primarily, to prevent undue stresses in other parts of the equipment.

When a helical spring is "close coiled" (i. e. wound so close that any one coil lies in a plane nearly perpendicular to the axis of the helix), the material (when acted upon by a thrust or a pull), is subjected to almost pure torsion, the twisting moment exerted on the bar being the product of the axial force (P), and the radius (R) of the centre line of the bar, i. e. the mean radius of the coils. If, however, the helix is "open-coiled" (i. e. if the angle of the helix is considerable), the assumption that the bar is subjected to pure torsion only, is not as admissible as the axial force causes a bending of the coils in addition to the torsion due to the twisting moment. Furthermore, in all cases, whether of open or closed-coiled springs, there is on every cross-section of the bar a shearing force parallel to and due to the axial load (P), apart from the torsional shear. It is usual to design coil springs for the principal stress (torsional stress), and neglect those stresses which are due to bending or direct shear, as the latter complicate the calculations, and even then

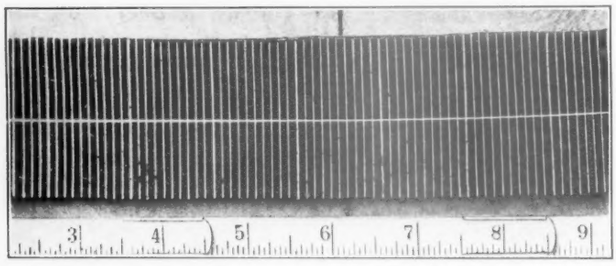


Fig. 3—Representing Unstrained Condition of Spring Material

change the results but slightly. When it is considered that, in addition to the differences due to the method of calculation, the size (diameter) of the bar may vary, and thus alter the solid height of similar springs built from the same length of blunt bar, that there may be slight variations in the diameter of the coiled spring and also in the pitch or space between the various coils, it is hardly to be expected that test results will check exactly with the calculated values. Moreover the manner in which the ends are formed will have some influence upon the free height, and the height at various loads of springs that may be otherwise identical. In fact, if a spring similar to the one shown in Fig. 1 at *D* be first tested with the ends "dead" or in contact and then the spring be heated, the ends sprung out slightly as shown in Fig. 1 at *B*, and then retempered, the free height will be appreciably increased; this difference in height decreasing as the spring is loaded. The extent to which the ends are in contact with the adjacent coils will also have considerable influence upon the action of the spring for, in extreme cases, the first coil may be entirely in contact and may not in reality be an effective (active or working) coil; in such a case it would not be correct to assume the total number of coils as working coils. The above mentioned factors being rather exceptional, we will consider all coils as effective.

In addition to the influence of the various factors mentioned above, the deviation of the practical from the theoretical is still further increased by the fact that when a bar is coiled a certain distortion of the material takes place. The amount of this distortion increases as the ratio of the diameter of the rod to the diameter of the coil decreases, and is much more pronounced in the case of square bars than in the case of round bars.

As a simple example illustrative of the distortion which takes place when a bar of square cross sectional area is bent to the arc of a circle, as is the case when it is coiled to form a spring, a piece of dental rubber gum, formed by cementing together four thicknesses of rubber, and having a total thickness of 0.15 in. was ruled up in an unstrained position, as shown in Fig. 3. Two plates of glass, each slightly thinner than the rubber, were then cut to the curvature to which it was desired to make the rubber conform; the one to bear

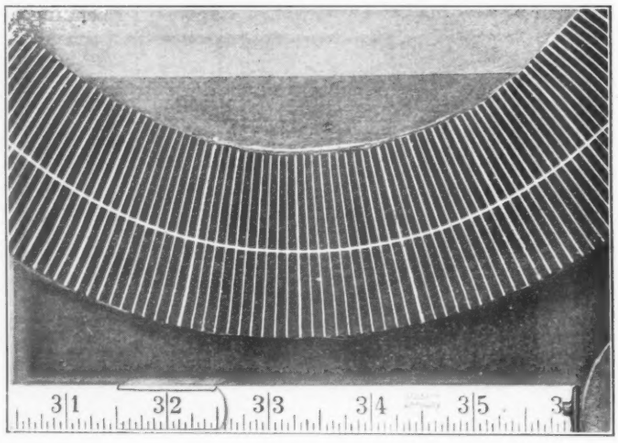


Fig. 4—Showing Distortion of Spring Material When Bent

against the concave side and the other against the convex side. The rubber was then placed between and in contact with the curved edges of the two glass plates, and the whole placed between two other glass plates for the purpose of preventing the rubber from "buckling" and for forcing it to assume the curved position shown in Fig. 4.

The resulting distortion is noticeable, not only in the decrease in the distance between the lines at the inner edge of the curve, and the corresponding increase at the outer edge, but also in the shifting of the straight line, originally

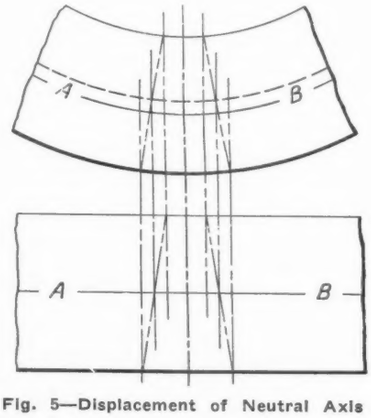


Fig. 5—Displacement of Neutral Axis

midway between the edges, toward the tension edge. The material, being bent by the two curved plates and prevented from buckling by the glass plates above and below, suffers a movement of the line representing the original location of the neutral axis away from the compression edge and toward the tension edge. It should be constantly borne in mind that the neutral axis is not necessarily at the center of gravity of the section, but at the neutral or zero value of the stresses in the section. If this is understood, it will be readily seen that the neutral axis will change its location, now being

nearer the compression or concave edge. The two statements above, regarding the movement of the line representing the original location of the neutral axis toward the tension edge, and the actual neutral axis in the bent rubber being nearer the compression edge, may seem to be contradictory. That the line, originally in the center of the rubber in Fig. 3, is nearer the tension edge in the bent condition is evident from Fig. 4. While the deformation in the rubber is elastic, the action is similar to that in the plastic de-

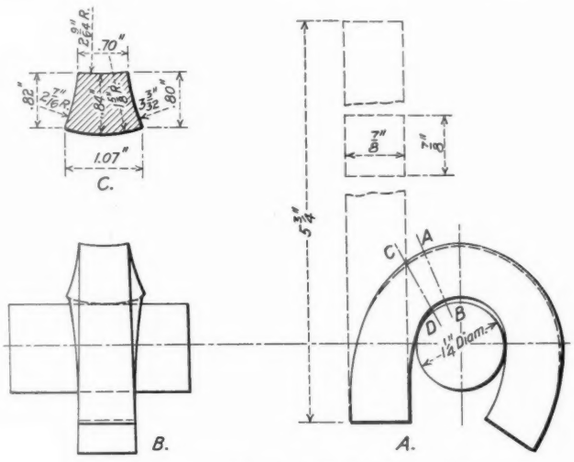


Fig. 6—Example of Plastic Deformation

formation shown in Fig. 7. The location of the neutral axis or zero stress line in the bent rubber is shown in Fig. 5. The unstrained condition of the rubber is illustrated in the lower part of the figure, with the original longitudinal axis shown by *AB*. The strained condition illustrated above shows the line *AB* as it appears in Fig. 4. With equal elongations and contractions, at the outer edges, the neutral axis in the curved beam is now between the line *AB* and the compression edge as shown by the dotted line. A similar

Fig. 7—Photograph of Deformed Bar and Its Section

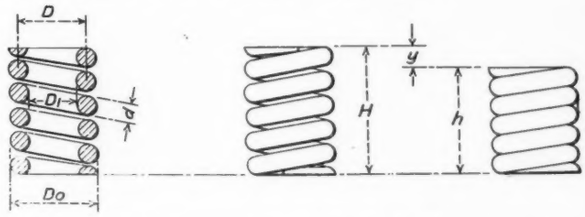
analysis may be applied to the vertical lines (now radial) of Fig. 4. This shifting of the neutral axis constitutes the fundamental difference between the theory of straight and curved beams.

The photograph of the rubber in the unstrained position, Fig. 3, was taken subsequent to the bending test, Fig. 4, and it is apparent that the deformation was "elastic" since the rubber assumed its original position.

As an example of plastic deformation the 7/8 in. square bar indicated by the dotted lines in Fig. 6 at *A* was heated to a cherry red, and bent around a rod 1¼ in. in diameter as shown by the full lines. The bent bar was then sawed in two at the sections *AB* and *CD*, and a photograph of the section (*AB* side) is reproduced in Fig. 7, the inner part of the curve being at the top. The dimensions of the section are given at *C* in Fig. 6. The part of the bar remaining after the section was removed is shown in Fig. 6 *B*, and at the left in Fig. 7.

The foregoing illustrates to an exaggerated scale, an important readjustment of the cross sectional area of a square bar when coiled to form a spring; this feature, though quite often overlooked, should be taken into consideration when estimating the blunt length of a square bar required to give a desired solid height, since, otherwise the actual solid height of a spring made from a bar whose length was determined exactly by a formula will be greater than that desired due to the increase in width parallel to the axis of the spring.

Having thus briefly directed the reader's attention to a few of the many factors, which are a circumstance of manufacture and which influence to a greater or less degree the values determined by the common spring formulae, the calculated and test results of a few springs selected at random from a small order will now be presented. The following notation (see Fig. 8) will be used throughout.



D_0 = outside diameter of spring, in inches.
D_1 = inside diameter of spring ($D_0 - 2d$), in inches.
D = mean diameter of spring ($D_0 - d$), in inches.
R = mean radius of coil $\left(\frac{D}{2}\right)$ or $\frac{1}{2}(D_0 - d)$, in inches.
d = diameter of bar, in inches.
L = blunt length of bar before coiling, in inches.
G = Modulus of torsional elasticity. The values of different investigators vary from 10,000,000 to 14,000,000. The value of 12,600,000 will be used throughout.
H = height of spring when free, in inches.
h = height of spring when solid, in inches.
y = total deflection (H — h), in inches.
n = number of coils $\left(\frac{h}{d}\right)$
P = load required to close the spring, in pounds.
S = maximum stress (shear) when coils are in contact. In the examples given a value of S = 80,000 will be used unless otherwise noted.
π = 3.1416.

Fig. 8—Notation for Spring Computations

Now, it is plainly evident that, having given the solid height *h* of the coil and the diameter *d* of the bar, the total number of coils is equal to the solid height of the spring divided by the diameter of bar, or:

$$n = \frac{h}{d}$$

and that the total length of the bar *L* is equal to the product of the circumferential length of the mean diameter of one coil and the number of coils or:

$$L = \pi D n \quad \text{and } n = \frac{L}{\pi D}, \qquad \ldots\ldots(1)$$

Similarly, the solid height of the spring is equal to the product of the diameter of the bar *d* and the number of coils *n* or:

$$h = d n \quad \text{and } n = \frac{h}{d}$$

Therefore, referring to equation (1):

$$\frac{h}{d} = \frac{L}{\pi D} \quad \text{and } h = \frac{d L}{\pi D} \qquad \ldots\ldots(2)$$

From this equation the value of L may be determined when d, D and h are known:

$$L = \pi\left(\frac{D}{d}\right)h \quad \text{or} \quad L = 3.1416\left(\frac{D}{d}\right)h$$

When n and R are known the blunt length of the bar may be found from the equation:

$$L = 2\pi n R = 6.2832\, n R \qquad (3)$$

In designing springs certain requirements must be adhered to, and the method of procedure will in many instances depend upon what these particular values are. While the values arbitrarily selected for the fibre stress may vary considerably, depending upon the service to which the spring is to be subjected and the experience and discretion of the designer, we will select as the basis of the two fundamental formulae the fibre stress S and load P when the spring is closed. These are determined by the following equations, viz.:

The fibre stress S, when all values except P and S are known is equal to:

$$S = \frac{d\, y\, G}{2\, R\, L} \qquad (4)$$

The load or capacity P, when all other values are known, is equal to

$$P = \frac{\pi\, S\, d^3}{16\, R} = \frac{0.19635\, S\, d^3}{R} \qquad (5)$$

In order to clear up any misunderstanding which may result from the fact that only a few of the values appear in the above formulae, the values of L and S may be substituted and the value $(H—h)$ used in place of y. Thus equation (4) becomes:

$$S = \frac{d\,(H-h)\,G}{2\,(D_0-d)\,\pi\, n\, R} \qquad (6)$$

and substituting $\dfrac{d\,(H—h)\,G}{2\,RL}$, for S equation (5) becomes:

$$P = \frac{\pi\, d^4\,(H-h)\,G}{32\, R^2\, L} \qquad (7)$$

or substituting the value, $2\,\pi\, n\, R$ for L:

$$P = \frac{d^4\,(H-h)\,G}{64\, R^3\, n} \qquad (8)$$

The deflection y when h, d, D, S and G are known, may be obtained from equation (4):

$$y = \frac{S\, D\, L}{G\, d} \qquad (9)$$

$$\text{but } L = \pi\left(\frac{D}{d}\right)h$$

$$\text{hence, } y = \frac{\pi\, S}{G}\left(\frac{D}{d}\right)^2 h \qquad (10)$$

To facilitate the use of the above formulae, a few applications will be given.

Example 1:
Outside diameter = 9½ in.
Diameter of bar = 1⅝ in.
Solid height = 7½ in.

To find the deflection y, substitute in equation (10):

$$y = \frac{3.1416 \times 80{,}000}{12{,}600{,}000}\left(\frac{7.875}{1.625}\right)^2 \times 7.5$$

$$y = 0.019947 \times 23.485 \times 7.5 = 3.61 \text{ in.}$$

To find the deflection when H, d, D_0, S and G are known, substitute in equation (10):

$$y = \frac{\pi\, S}{G}\left(\frac{D}{d}\right)^2 h, \text{ but } H = h + y$$

$$\text{Hence, } H = h + \frac{\pi\, S}{G}\left(\frac{D}{d}\right)^2 h \qquad (11)$$

$$H = \left[1 + \frac{\pi\, S}{G}\left(\frac{D}{d}\right)^2\right] h \qquad (12)$$

$$\text{or } h = \frac{H}{1 + \dfrac{\pi\, S}{G}\left(\dfrac{D}{d}\right)^2} \qquad (13)$$

$$\text{Hence, } y = \frac{\pi\, S}{G}\left(\frac{D}{d}\right)^2 \frac{H}{1 + \dfrac{\pi\, S}{G}\left(\dfrac{D}{d}\right)^2} \qquad (14)$$

multiplying the numerator and the denominator of equation (14) by $\dfrac{G}{\pi\, S}\left(\dfrac{d}{D}\right)^2$ we have:

$$Y = \frac{H}{\dfrac{G}{\pi\, S}\left(\dfrac{d}{D}\right)^2 + 1} \qquad (15)$$

Example 2:
Outside diameter = 6⅛ in.
Diameter of bar = 1⅛ in.
Free height = 11⅛ in.

To find the deflection. Substituting in equation 15,

$$y = \frac{11.125}{\dfrac{12{,}600{,}000}{3.1416 \times 80{,}000}\left(\dfrac{1.0625}{5.0625}\right)^2 + 1}$$

$$y = \frac{11.125}{50.1337 \times \dfrac{1}{22.705} + 1} = \frac{11.125}{2.208 + 1}$$

$$y = \frac{11.125}{3.208} = 3.47 \text{ in.}$$

For any other value of y as, $y = 3\frac{5}{8}$ in. the change in fibre stress is found by direct proportion (see equation 9), or

$$\frac{3.625}{3.47} \times 80{,}000 = 83{,}600 \text{ lb. per sq. in.}$$

The following example shows how the solid height is obtained when H, D_0, d, S and G are known.

Example 3:
Outside diameter = 5½ in.
Diameter of bar = 1¼ in.
Free height = 12 in.

Substitute in equation (13) as follows:

$$h = \frac{12}{1. + 0.019947\left(\dfrac{4.25}{1.25}\right)^2} = \frac{12}{1. + 0.019947 \times 11.56}$$

$$h = \frac{12}{1. + 0.23059} = \frac{12}{1.23059} = 9.751 \text{ in.}$$

Thus a spring having a solid height of 9¾ in., and a free height of 12 in. would give a total deflection of 2¼ in. with a maximum fibre stress of approximately 80,000 lb.

In designing an inner coil to work with the coil of Example 3, that is to conform to the same free and solid heights, and the same fibre stress, it will be necessary to maintain the same ratio of $\dfrac{D}{d}$ which, for the outer coil, is 3.40.

The outside diameter of the inner coil, allowing ⅛ in. clearance, will be 4⅛ in.

Selecting at random a value of d for the inner coil of, say, ¾ in., we obtain the following results:

$$D = D_0 - d = 4.125 - .75 = 3.375 \text{ in.}$$

$$\text{and } \frac{D}{d} = \frac{3.375}{.75} = 4.50$$

Let us see what would result if a value of 4.50 for $\dfrac{D}{d}$ was used for the inner coil, and 3.40 for the outer coil. Assuming the solid and free heights of 9¾ in. and 12 in. were adhered to for the inner coil, the fibre stress when solid would be 60,440 lb. per sq. in. instead of 80,000 lb. per sq. in. as for the outer coil. The free height of this coil could be increased in proportion to the increase in $\dfrac{D}{d}$, or to give a deflection of

$$\frac{4.50 \times 2.0}{3.40} = 2.67 \text{ in.}$$

making the free height

$$9.75 + 2.67 = 12.42 \text{ in.}$$

The fibre stress could also be increased by decreasing the outside diameter of the coil and using a ¾-in. bar, as in the above case, but this would result in a decrease in the capacity of the spring. Furthermore, as a general rule, all the space available is necessary, and in such cases it is better to decrease the value of $\dfrac{D}{d}$ by increasing the value of d.

(To be continued.)

FALLACIES REGARDING MALLEABLE IRON

The Extent of Its Usefulness Under the Modern Methods of Manufacture Generally Underestimated

BY A. H. WESTON
Sales Engineer, T. H. Symington Company

THERE are a number of fallacies, both in connection with the manufacture of malleable iron castings and with the physical characteristics of the metal itself, which are unfortunately still entertained as facts by many engineers. These fallacies, based largely on hearsay, and to some extent on experience with the product of manufacturers who have not kept in touch with developments in this industry in the past few years, may be cited as follows:

(1) That the strength and ductility of malleable iron castings lie principally in the skin.

(2) That malleable iron castings with thickness of sections exceeding ½ in. cannot be completely annealed.

(3) That malleable iron castings are frequently over annealed.

(4) That the ultimate tensile strength of malleable iron

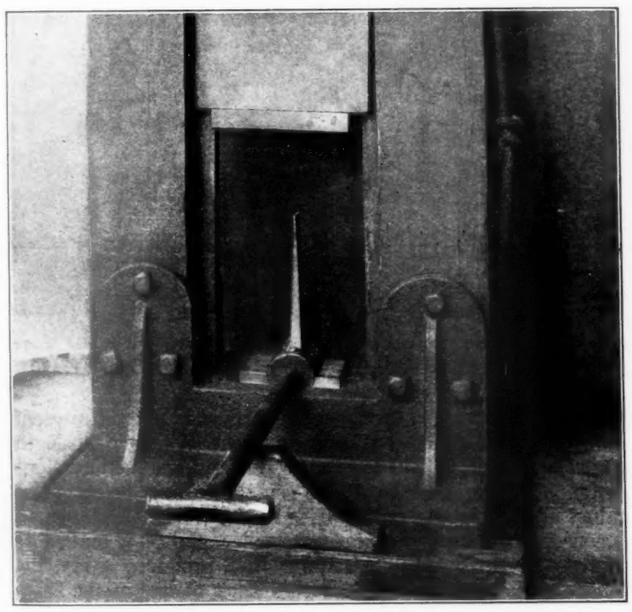


Fig. 1—Wedge Method of Testing the Ductility of Malleable Iron

does not average much over 40,000 lb. per sq. in., and the average elongation does not exceed 6 per cent in 2 in.

(5) That malleable iron is frequently unreliable, due to non-uniformity in methods of manufacture.

The outer skin of a malleable casting does not by any means supply the major part of its strength and ductility, as the core has both of these qualities. In fact, there is very little, if any, difference between the strength of the metal in the core and that in the skin.

A malleable iron wedge is shown in Fig. 2, which has been subjected to the wedge test adopted as one of the standard test practices of the Associated Manufacturers of Malleable Iron. For this test the wedges are cast 1 in. wide by 6 in. long and are ½ in. thick at the base, tapering to 1/16 in. at the top. They are held upright under a small drop hammer shown in Fig. 1, and are repeatedly struck by this hammer until fracture commences. Each blow delivers 70 ft.-lb. of energy. The number of blows required to start fracture and the shortness of the uncurled portion of the wedge are taken as one means of measuring the strength and ductility of the iron.

The record of the following test conclusively proves the ductility of the core of a malleable casting. Several of the wedges as above described were cast of the standard width and length, but were made five-eighths inches thick at the base and three-sixteenths inches thick at the top. These wedges then had one-sixteenth inch machined off the 1-in. by 6-in. faces, leaving a wedge of the same dimensions as the unmachined standard wedge. Since the skin of a malleable casting is only about one thirty-second in. thick, the removal of one-sixteenth in. insured the removal of the skin. After machining, these wedges were put under the drop-hammer and subjected to the standard test. Their appearance after test was as shown in Fig. 3.

These results compared with tests made at the same time of unmachined wedges from the same furnace and annealed in the same oven are tabulated below:

	Unmachined wedges, blows.	Machined wedges, blows.
Afternoon heat, June 3	18.5	13.20
Afternoon heat, June 4	29.75	26.30
Afternoon heat, June 6	19.75	21.20
Average	22.67	20.27

It will be noted that the average result of the three tests of unmachined wedges is but slightly above that of three

Fig. 2—Malleable Iron Wedge Tested Under the Drop Hammer Shown in Fig. 1

tests of machined wedges, and in one case a machined wedge actually stood more blows than an unmachined wedge. Assuming this one case to be unusual and considering only the other comparative results, it is evident that malleable iron, even with its skin removed, is both ductile and dependable.

All parts of a malleable iron casting, even if the sections are as thick as 2 in., can be completely, thoroughly and uniformly annealed. The micrographs shown in Fig. 4 are illustrative of this fact. These micographs show the typical

structure of first class malleable iron after anneal, the white areas being ferrite (pure iron) and the dark spots temper carbon. The structures shown range from the extreme edge to the exact center of a 2-in. section. It will be noted that the structure is practically the same in every case.

Heavy malleable iron castings are readily annealed, and insofar as this last step in the production of malleable iron is concerned, the process with heavy section castings is not different from that used with castings of light section. All that is required to anneal malleable iron castings is to raise them to a temperature at which the cementite and pearlite in the hard iron break down into ferrite (carbonless iron) and carbon, to give the action time to be completed and to cool slowly. It is obvious that a heavy section casting can be heated to the annealing temperature as readily as one of light section; for no matter how heavy a mass may be it can be heated throughout to any desired temperature if surrounded by a medium at that temperature for a sufficient time. The annealing of malleable iron requires about seven days, more than enough time for a heavy section to reach the temperature of its surroundings.

The annealing process, however, is not the one which alone controls the successful production of heavy malleable iron castings. An equally important factor is the foundryman's close adherence to the somewhat different procedure required in the production in the "hard iron" of castings of heavy section from that required for castings of light section. Regardless of thickness of section the prerequisite in making good malleable iron is to have practically all the carbon in the "hard" or "white iron" castings in the "combined" state. If carbon to any extent occurs there in the uncombined state the iron will be bad. Several factors tend to cause this condition—notably excessive carbon or silicon in the molten metal at time of pouring, and rate of cooling.

The rate of cooling has a very sensible influence on the appearance of "uncombined" carbon in the "white iron" castings; the slower the iron cools in the mold the greater the tendency for graphite to separate out. Obviously a casting 2 in. thick will cool much slower than one of ⅜-in. section. Consequently, in the manufacture of heavy-section castings the carbon or silicon, or both, in the molten metal must be lower than when light-section castings are made. This is taken care of by the operation of different furnaces with charges suitable for very light work, medium weight work, or for very heavy castings.

Malleable iron castings cannot be over-annealed. It has

Fig. 3—Machined Malleable Iron Wedges Tested to Show the Ductility of the Core Metal

been determined by very exhaustive tests that no marked deterioration in quality results if a casting is exposed to the proper annealing temperature for even four or five times the normal length of time of the anneal. This fact is evident from the appearance of the fractures shown in Fig. 5, which illustrate malleable iron that had been annealed from one to eight times. The strength and ductility of the iron showed no noticeable change until after the fifth anneal, and even then the deterioration was very slight. The illustrations of the fractures, made from ordinary photographs of the polished and etched sections, indicate that after the second anneal a ring of pearlite appears, working steadily towards the center during each successive anneal. The structure on each side of this ring is still the free ferrite and carbon characteristic of superior malleable iron.

It is true that malleable iron castings can be burned, as can all iron and steel products, if heated to too high a temperature, but in all malleable iron foundries deserving of the term "modern" the annealing ovens are equipped with an electric pyrometer with terminals at various points in the ovens. In this way the temperature throughout the ovens is accurately known at all times.

Malleable iron with a tensile strength of 38,000 lb. per sq. in. and an elongation of five per cent in 2 in. was con-

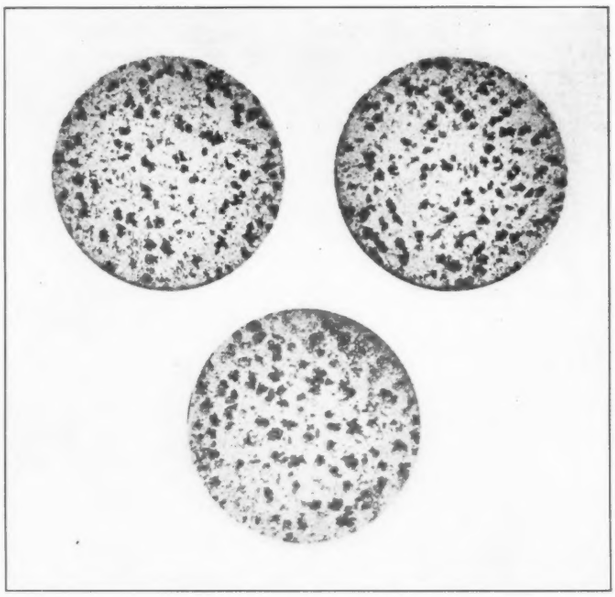


Fig. 4—Photo-Micrographs Showing the Structure, From the Edge to the Center, of a Malleable Iron Casting of Two-Inch Section

sidered satisfactory under the old methods. At the present time good malleable iron has an average tensile strength somewhat above 45,000 lb. per sq. in. and an average elongation of 8 per cent in 2 in., seldom falling below these values and frequently rising above them. That this statement is conservative and as indicative of what quality of malleable iron can be produced and is quite often produced today, the following data, taken from a record book of one of the association's foundries, show 16 consecutive heats from one furnace:

Heat	Tensile strength, lb. per sq. in.	Per cent elongation in 2 in.
November 1, A. M.	53,800	10.91
November 1, P. M.	57,300	10.51
November 2, A. M.	56,100	11.71
November 2, P. M.	54,400	12.50
November 3, A. M.	55,800	12.50
November 3, P. M.	54,100	11.71
November 4, A. M.	54,100	11.73
November 4, P. M.	53,800	10.95
November 5, A. M.	56,100	14.09
November 5, P. M.	60,000	14.05
November 6, A. M.	52,100	7.89
November 6, P. M.	54,100	10.90
November 8, A. M.	55,400	9.37
November 8, P. M.	55,100	10.89
November 9, A. M.	57,700	9.42
November 9, P. M.	55,400	14.09
Average	55,300	11.45

The Associated Manufacturers of Malleable Iron have recently voluntarily adopted a specification for railroad malleable iron castings, applying to the product of some 30 member companies, embodying a minimum tensile strength of 45,000 lb. per sq. in. and a minimum elongation of 7½

per cent in 2 in. This specification they will offer to all purchasers of such castings and agree that their product shall be accepted or rejected on this basis.

Assertions are still frequently made that malleable iron is unreliable due to non-uniformity in methods of manufacture and other defects inherent in this metal. This was doubtless true of the product as a whole some years ago, and may still be true of iron made by those manufacturers who have not kept abreast with recent developments, but it does not apply to malleable iron produced by the Associated Manufacturers of Malleable Iron. This association, comprising a large number of malleable iron manufacturers in this country, has had in its employ for some time metallurgical experts who have by patient research insured the production of an iron which is ductile, strong and uniform in quality. The three means of investigation made use of by these experts, and in continued use, are the chemical laboratory, the physical laboratory and photo micrography. Standards of procedure adopted by and compulsory with members of this association may be briefly described as follows:

After the castings are poured an analysis is made to disclose any irregularity in furnace operation and to give assurance that the desired composition of the iron is obtained. At the same time necessary test bars are cast from each heat to be used to determine the tensile strength, transverse strength and ductility. These test bars are distributed at different points in the oven in which the castings from this heat are annealed. After the castings, test bars and wedges have been annealed the bars and wedges are tested. Each one must come up to a certain standard before the castings are considered fit for service. If any bar fails to meet this standard, sections are cut from the casting, examined under the microscope, and the cause of the failure thus ascertained.

The following statement appears on page 13 of the 1914 report of the M. C. B. Committee on Car Construction:

"Malleable iron varies greatly in quality and is generally inferior to cast iron under loads subjecting it to pure compression. It is ductile, and has ability to resist shocks without cracking, which makes it superior to cast iron for car details not subjected to high tension or bending strains. It is greatly inferior to cast steel in strength and ductility. It should not be used subject to high tension nor bending strains, unless a breakage will not involve danger or damage to other parts of the car."

This statement, while without question made in good faith at the time of this report, if now reviewed by the same committee members would doubtless be considerably modified, but it unfortunately stands on record as part of the last published report of an M. C. B. Committee on Car Construction. The assertions made, with one exception, do not now apply, are misleading, and where seriously entertained by those not in touch with the great improvement in quality of malleable iron, are preventive of considerable economy in car and truck construction due to the unnecessary use in many cases of cast steel car members instead of the less expensive malleable iron parts.

With respect to the stated inferiority of malleable iron to cast iron, "under loads subjecting it to pure compression," this reiteration of a well known fact is superfluous, as the comparison made applies with equal force to all ductile steel products, and further, with the exception of wheels, the inability of cast iron to resist shocks should eliminate its use on freight cars.

It will be noted from the above quoted statement, that "malleable iron is greatly inferior to cast steel in strength and ductility," and further, "It should not be used subject to high tension or bending strains unless breakage will not involve danger or damage to other parts of the car." Comparing modern malleable iron with cast steel, the facts, proved by tests, controvert this opinion and recommendation.

In testing a cast steel rod having an ultimate strength of 65,000 lb. per. sq. in., the elastic limit was reached at 32,200 lb. per sq. in. A malleable iron bar, having an ultimate strength of 53,500 lb. per sq. in. under tensile test, showed an elastic limit of 38,500 lb. Thus the elastic limit of the malleable iron bar was 9.38 per cent higher than that of the cast steel bar. It would seem hardly necessary to emphasize the advantage of this particular characteristic of malleable iron when it is recalled that the elastic limit and not the ultimate strength is used by engineers as the proper basis in designing castings. Despite the high ratio of elastic limit to ultimate strength, the unquestionable ductility of malleable iron is proved by the wedge tests and by the figures given for percentage of elongation.

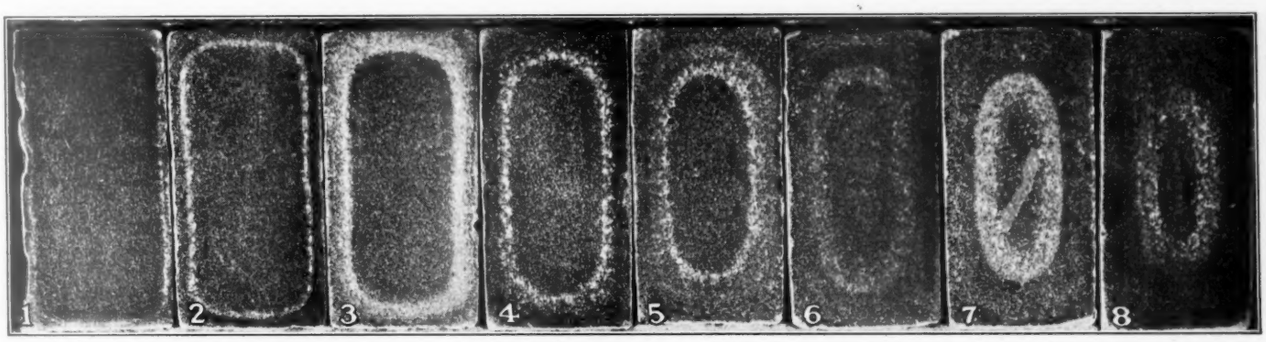


Fig. 5—Photographs of Polished and Etched Fractures Showing the Effect of Successive Annealings on Malleable Iron

The not infrequent failure of steel castings due to interior flaws which cannot be detected by surface inspection is a matter of common knowledge. Examination of steel castings which have failed in service will almost always disclose flaws in no way apparent on the exterior surfaces.

Malleable iron shrinks and cracks less than cast steel, and very rarely contains blow holes. This is because malleable iron castings are poured at a lower temperature than steel castings. The higher the temperature to which a metal is heated the more gas it takes up, with resultant greater liability to blow holes. Likewise the higher the temperature of the molten metal the more rapid its rate of cooling in the mold, with resultant tendency to shrinkage, flaws and cracks.

Much of the adverse opinion concerning malleable iron is due to the misconception as to its adaptability to heavy as well as light-section castings and lack of co-operation between designer and manufacturer. An engineer, with the erroneous belief that it will not do to design a malleable iron casting with sections in excess of ½ in. in thickness, has his attention called to such castings in service failing in considerable number, and forthwith decides on the substitution of a steel casting of such increased thickness as to weigh 60 to 100 per cent more than the malleable iron casting which it replaces. Had only a part of this additional metal

been put into a properly redesigned malleable iron casting, equal or better results would have been obtained with less dead weight and less expense. Again, an engineer without precise knowledge of the peculiarities of malleable iron designs a car casting in such a way as to cause hidden shrink cracks and internal strains sufficient to result in a large percentage of failure in service. Experience has demonstrated that by intelligent co-operation with the foundryman developments of this character are entirely avoidable. The malleable iron manufacturer knows his metal. With this knowledge he is well informed how best to design any given pattern so that unequal shrinkage in the component parts of the casting made from it will not occur, thus affording maximum strength for a given weight. While he may not be fully informed as to just what is required in service of a certain part, he knows that failure because of structural defects, at once apparent to the experienced malleable iron foundryman, can be avoided by making the casting a little thicker here, a little thinner there, bracketing at one place and altering at another.

Freight equipment draft gear and attachments are admittedly subjected to greater abuse in service than any other car members. Modern friction draft gears and many of the draft attachment parts have always been and are still made of malleable iron, and yet it is a matter of record that the percentage of failure of these malleable iron parts of friction draft gears and draft attachments is not greater than that of the steel couplers. As a matter of fact, malleable iron draft castings can be and are designed so as to make them proof against failure in the severest kind of service.

The writer submits that malleable iron as produced today by reputable manufacturers is on the whole just as dependable as cast steel, comparing the two metals in castings of the same thickness of sections and of length not over six feet. The truth of this statement, in view of the lower cost of the malleable iron casting, should merit the careful investigation of those designing and maintaining freight cars.

U. S. A. WAR LOCOMOTIVE

An excellent example of the response our industrial concerns give the government in time of war is shown by the rapidity with which the Baldwin Locomotive Works is supplying its order of 150 engines for service with the American troops in France. On August 11, just 20 working days after the order was placed, the first locomotive was completed. The contract was given precedence over all other work, either foreign or domestic, and the speedy construction was considerably facilitated by the similarity between these locomotives and the Consolidation locomotives which the Baldwin Locomotive Works have built for the British War Office. These two engines will be very much alike, the chief difference being that the American locomotives are equipped with superheaters while the British locomotives are not.

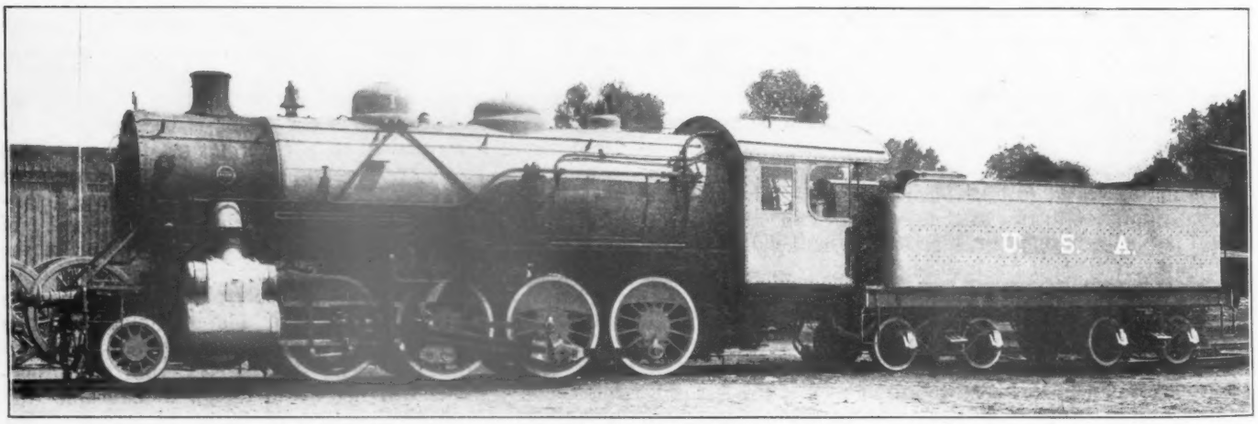
The locomotives are of standard gage; they weigh 166,400 lb. and will have a tractive effort of 35,700 lb. Their cost is said to be about $43,000 each. The general dimensions are:

Gage	4 ft. 8½ in.
Cylinders	21 in. by 28 in.
Driving wheels, diameter	56 in.
Total wheel base	23 ft. 8 in.
Driving wheel base	15 ft. 6 in.
Weight, total engine	166,400 lb.
Weight on drivers	150,000 lb.
Tractive effort	35,700 lb.
Boiler, diameter	70 in.
Boiler pressure	190 lb. per sq. in.
Number and diameter of tubes	5⅜ in.—26; 2 in.—165
Length of tubes	13 ft. 9 in.
Firebox	123 in. by 38¼ in.
Heating surface, firebox	181 sq. ft.
Heating surface, tubes	1,681 sq. ft.
Heating surface, total	1,862 sq. ft.
Superheating surface	420 sq. ft.
Grate area	32.7 sq. ft.
Tank capacity	5,400 U. S. gal.

On July 18 the Government placed orders for 300 large locomotives; during the past month it ordered no less than 764 more locomotives, this making 1,064 in all, and 6,000 30-ton standard gage and 2,997 narrow (1 ft. 11⅝ in.) gage freight cars, all for service with the troops in France.

The original locomotive order for 300 locomotives was for standard gage 80-ton Consolidation lcomotives and was divided evenly between the American Locomotive Company and the Baldwin Locomotive Works. The new order for 764 locomotives has been given entirely to the Baldwin Locomotive Works, and is especially interesting other than as to its size, because it includes a large amount of narrow gage equipment. The order includes 380 additional standard gage Consolidation locomotives; 195 600-mm. (1 ft. 11⅝ in.) gage Prairie type locomotives, 126 50-h.p., 600-mm. gage gasoline locomotives, and 63 30-h.p., 600-mm. gage gasoline locomotives. These orders will, of course, have preference over all other business.

Some people are under the impression that the order placed July 18 was the first order for locomotives ever placed by the United States Government. This is not the case. During the Civil War, Brigadier General D. C. McCallum, general manager of the United States Military Railroads in the Military Division of the Mississippi, had to purchase a large number of locomotives and cars for the Federal railways south of Nashville, Tenn. He acted under orders from Secretary of War Stanton, and found the railway supply industry on the job then just as he would find it now. "It is proper and just to state," he wrote, "that the requisitions of this order were met by all in a spirit of zealous patriotism. The manufacturers at once placed all their available force at work upon the engines and cars ordered, which were all completed and delivered in an unprecedented short time."



The First Locomotive Built for the United States Army in the Present War

POWDERED COAL FOR THE RAILWAYS*

A Summary of the Developments Made with This Grade of Fuel on the Railways During the Past Year

EVERY known method for its conservation should be thoroughly studied to determine what means of handling and burning fuel in locomotive and stationary boilers will result in the largest net saving in cost of transportation, on account of the large increase in the cost of fuel. The railways have experienced difficulty in obtaining the proper grade of fuel for locomotives. If pulverized fuel were used on the locomotives, it would not be necessary to have so many different grades of fuel, with the consequent increased number of cars under load.

The average mechanical delay on one of the largest roads at its heaviest running repair station is from 10 to 11 hours, and the lowest delay at its despatching stations is from 3½ to 5 hours, with an average of something over 6 hours for all stations. There is no question but that the elimination of the existing ash pit delays by the use of pulverized fuel would reduce the terminal delay to one-half of what it is at the present time, and this opportunity for relieving the yard congestion would seem to be the most efficient and economical means for increasing the net earning capacity of the railroads.

The committee also wishes to bring attention to the fact that only about two-thirds of the total fuel purchased for locomotive operation is actually utilized while hauling trains, the remaining one-third going into the so-called "stand-by" loss, including the cleaning, building and maintaining of fires on grates during the period the engine is standing or otherwise not utilizing steam for locomotion, either light or with train.

The advantages of pulverized fuel are also represented through increased handling capacity due to sustained boiler capacity and larger exhaust nozzles; simplified means of stoking and burning the fuel; and by the elimination of smoke, sparks, cinders, fire cleaning, grates, ash pans, smokebox draft appliances and firing tools.

The field for development of pulverized fuel in railway blacksmith shops (see *Railway Mechanical Engineer,* March, 1917, page 123), would appear promising, and many investigations are being made, but the committee is not aware of such use of the fuel by railways up to the present time.

Effect of Pulverized Fuel on Transportation.—The total amount of fuel required can be regulated to cover any service demands made upon the boiler up to practically the capacity of the injectors. On hard drags, steam can be held against the water as with no other fuel except oil, and the always losing bargain of "trading water for steam" is not necessary. If the heavy demand is of long duration, no loss in steam will result, as obtains when burning coal on grates by reason of the fire becoming heavy and clinkered, or full of banks or holes. "Slugging" with pulverized fuel will result in pressure reduction, the same as will too light firing. When the work of the engine eases off the fuel supply can be at once reduced accordingly, and on long drifts or where the train is set off along the road, the supply may be stopped entirely, thus putting out the fire. This range of firing from full load to no load is all controlled most easily by the fireman.

The item of grate repairs, necessitating dumping the fire, with, in consequence, a considerable delay, is done away with. Front ends need little attention, as there can be no filling up with cinders nor clogging of netting—first, because no cinders are carried over, and second, because there is no netting. If engines are being held for any length of time, there is no holding over of fires, with considerable cost and a second cleaning before service often necessary, nor is there the expensive dumping and comparatively slow fire-building on call to contend with. A pulverized fuel burning locomotive can be on its train, ready to go, in one hour from time fire is started, under ordinary engine house conditions.

The firing up time for a mixture of anthracite and bituminous coal is as follows, these figures being the average of a large number of actual observations of this matter:

MIXTURE.

Approximately 60 per cent anthracite and 40 per cent bituminous.

Initial Temp. of Water in Boiler	Time to Raise to 150 lb. Steam
70 deg.	52 min.
100 deg.	44 min.
200 deg.	35 min.

This is about as fast as it is proper to fire up a boiler. On the arrival at end of the run, the engine can be placed in the house in 15 or 20 minutes after being cut off from its train. There is, of course, work sometimes to be done in the firebox of an engine, using this fuel, such as brick repairs and the removal of slag from the furnace, and in such cases several hours must elapse after the time of extinguishing the fire, on account of the brickwork retaining its heat, as in the case of an oil burner. With properly prepared fuel, correct furnace design and intelligent operation, no trouble from honeycomb will appear, and the brickwork will also have a reasonable life.

Delays at the fueling plant will not be of moment, as fuel is now taken at an average rate of about 10 tons in from 10 to 12 minutes, and this can be accelerated by enlarging the fueling outlets. This fuel does not freeze in the bins.

Delays on the road for steam or other causes are reduced. The effect of weather on steam making is reduced by reason of the fact that no fuel saturated with rain or mixed with ice and snow is thrown into the firebox to reduce its temperature below normal.

The apparatus itself is getting pretty well standardized and, if given the care that any locomotive machinery should have, will operate without failure indefinitely.

Safety in train operation is enhanced by the fact that the fireman rides his seat practically over the entire road and can, and should, devote a large part of his attention to track and signals. The glare from the firebox door, especially at night, when it is sometimes very annoying as regards track observation, is eliminated.

The fireman is able, at all times, to assist the engineer in whatever way desirable to enhance the safe and speedy handling of the train. The use of pulverized fuel will react to give higher grade engineers in the future than could be expected if the laborious grate-firing methods are continued.

Handling Pulverized Fuel.—To economically handle coal from the mines to the pulverizing plant, it should be loaded in drop bottom cars so that they can be placed over a pit which is below the track level, the coal dropping into the hopper bottom pit by gravity through a gate to a crusher and from the coal crusher to a conveyor. This conveyor delivers the coal to a magnetic separator or other suitable means used for eliminating small pieces of metal that may have gotten into the coal; then into a boot leg of a bucket hoist which elevates the coal to a bin which also has a hopper bottom directly located over the coal dryer; from there it passes through a reciprocating feeder which can be regulated to feed the amount of coal required into the dryer. The coal passing through the dryer is dropped into another boot leg bucket hoist, where it is elevated to a dry coal bin directly over

* Abstract of the committee report on Powdered Coal presented at the 1917 convention of the International Railway Fuel Association.

the pulverizing mill. After the coal has passed through the pulverizer it is either raised by a bucket hoist and delivered to the storage bin, or is raised from the pulverizer by air separation or blown in by a fan blast. This depends, of course, upon the kind of pulverizing mill used.

From the storage bin (which is a tank of desired capacity, having a tapered bottom to the outlet), it is delivered to the locomotive tender by a flexible spout which fits into one of the filling holes in the engine tender, the opposite filling hole being connected by a 6-in. flexible pipe which runs to the top of this storage bin. This acts as a vent so that the air, which is displaced by the coal that is passing into the tender, is returned into the storage tank, thereby eliminating all chance of dust blowing around the engine. This storage tank is equipped with a vertical screw about 10 or 12 in. diameter, passing through the center and down to within five or six inches from the bottom and is for the purpose of keeping the coal dust moving. This is operated by a small motor located on top of this storage tank, and controlled by man filling engine tender, and by its use it is possible to fill a 14-ton tender in six minutes. The valve used on the bottom of this storage tank is of the gate or stop-cock type with 10 or 12-in. opening. The sheet iron slide valve used at some plants proved unsatisfactory for shutting off the flow of coal. We believe, however, that there is an opportunity to design a special valve that will work more satisfactorily than the gate or stop valve.

Burning Pulverized Anthracite Refuse.—About 5,600,000 tons of wasted culm from the anthracite coal fields is available for use as powdered coal. This has a heat value of 11,500 B. t. u. The raw slush or culm, before drying, will contain from 8 per cent to 30 per cent (and sometimes more) moisture. It can be seen from the above that this is not very attractive fuel for ordinary firing methods and burning on grates. Drying, pulverization and handling is accomplished in the usual manner, the product averaging about 14 per cent through a 100 mesh screen and 86 per cent through a 200 mesh. No difficulty is experienced in handling, but the wear on the type of pulverizer in use is somewhat higher than when straight bituminous is being worked.

Locomotive 1200 on the Delaware & Hudson is in regular operation, in heavy freight service, burning a mixture of 60 per cent of the above fuel and 40 per cent of pulverized bituminous coal. Varying mixtures of these two fuels have been tried with this engine, but the one mentioned above seems to give the best all-around results, although developments to increase the percentage of anthracite are now being made.

There is, however, a large Stirling boiler of 463 rated horsepower on the Delaware & Hudson, which operates very successfully with the straight pulverized anthracite. When starting up this boiler, pulverized bituminous is used until the refractory material in the boiler furnace is well heated, after which anthracite is burned alone and very satisfactorily.

Development on the Delaware and Hudson.—The Delaware & Hudson operates in the anthracite coal fields of Pennsylvania. In this field there is available approximately 550,000 tons per month of anthracite fine dust which cannot be burned on grates. This road built a locomotive to endeavor to utilize the waste anthracite product (see *Daily Railway Age Gazette,* June 16, 1916, page 1384.)

This locomotive is hauling over a 1.65 per cent grade one and one-half miles long with 6-deg. curves, a train load of 1,562 actual tons, or 23 loads. On a 0.6 per cent grade it is reported to be hauling 2,500 actual tons, or an increase of 13½ per cent over its calculated capacity of 2,200 tons.

On a recent trip between Carbondale, Pa., and Oneonta, N. Y., a district run of 94 miles, it handled 3,458 actual tons in a train of 57 loads, and successfully negotiated a ruling grade made up of one and one-half miles of 0.4 per cent, one-half mile of 2 per cent, three-fourths mile of 0.48 per cent, and two and one-half miles of 0.3 per cent grades.

The stationary Stirling boiler, referred to above, has been giving satisfactory results. From test reports of the railroad company a maximum evaporation of over 27,000 lb. of water per hour, corresponding to 170 per cent rating, has been attained and under average working conditions the boiler delivers about 130 per cent of rating. In both cases the continuous CO_2 recorder shows an average of about 16 per cent. The maximum observed equivalent evaporation from and at 212 deg. was 9.6 lb. of water per pound of dry coal, and the average was 8.9 lb. These results are very good when compared with hand-firing of steam sizes of anthracite coal in stationary boilers of this type. Under these latter conditions, an evaporation of from five to six pounds of water which may be attained with an average flue gas CO_2 content will run from 10 per cent to 12 per cent. The matters of fire cleaning and removal of slag and clinkers are respectively eliminated and very much simplified by the use of pulverized anthracite. The use of this fuel will release other and more valuable (commercially) coals to the general market and reduce the boiler plant labor from 30 to 50 per cent.

The following are some additional data:

Tests on Stirling Type Boiler with Pulverized Fuel.

Test No.	1	2	3
Duration, hours	336	48	240
Horsepower rating	463	463	463
Horsepower developed (per cent)	135	178	118
Fuel	Anth.	Anth.	Anth.
Kind	B. E.	B. E.	Slush
Dryness (per cent)	0.65	0.65	0.8
Fineness (per cent through 200 mesh)	86.0	86.0	86.0
Evaporation from and at 212 deg. F. (lb.)	8.9	9.8	8.1
CO_2, average (per cent)	16.3	16.6	16.5
Vacuum in breeching uptake, in. of water	0.23	0.33	0.28
Vacuum in combustion chamber, in. of water	0.14	0.16	0.19
Boiler pressure, average (lb.)	142	140	144
Flue gas temperature, deg. F. average	525	603	580

Comparing the performance of anthracite bird's-eye, hand fired, on grates equipped with forced blast below and induced draft above the fire, with the same fuel pulverized and burned in suspension, there is an increase of over 40 per cent under the latter conditions.

It may be stated generally that the steam generating capacity of the boilers now burning bird's-eye anthracite on grates is about doubled by the use of pulverized anthracite slush, and at the same time the boiler plant labor cost is reduced about 40 per cent, account of it not being necessary to clean fires, and lessened amount of ash to be handled when all boilers are equipped for burning fuel in pulverized form.

Development on New York Central Lines.—The New York Central has equipped one of its Pacific type freight locomotives with pulverized fuel burning apparatus and are now conducting tests of various Pennsylvania bituminous fuels in freight and passenger service, between Albany and Utica, N. Y., on runs of about 95 miles, with the idea of perfecting the use of this coal in pulverized form as a substitute for fuel oil in the Adirondack forest district. The committee understands that these tests are nearing completion and the results have been quite satisfactory.

The locomotive referred to is known as class K-11-D, having the following dimensions:

Cylinders (in.)	26 by 26
Tractive power (lb.)	38,980
Weight on drivers (lb.)	174,500
Weight on engine truck (lb.)	48,500
Weight on trailer (lb.)	47,000
Total weight (lb.)	270,000
Driving wheels (in. diameter)	69
Total firebox heating surface (sq. ft.)	232
Total boiler heating surface (sq. ft.)	3,769.1
Superheater heating surface (sq. ft.)	775
Boiler pressure (lb. per sq. in.)	180

It is reported that the pulverized fuel equipment has given absolutely no trouble to date, no failures of any kind having occurred.

Development on the Chicago and North Western.—The temporary pulverizing plant installed to prepare the fuel for test purposes has been abandoned, and it is understood that

plans are under way for the installation of a permanent fuel preparing and handling plant, and the equipping of additional passenger and switching locomotives.

Development on the Missouri, Kansas and Texas.—The Missouri, Kansas & Texas is now firing 3 batteries, each of two 250 h.p., Heine-O'Brien type of boilers, set originally for burning natural gas, with powdered coal. The boilers were changed by adding a Dutch oven, side cleaning doors, and changing the baffles from horizontal to vertical.

Coal from three districts has been used, having about the following proximate analysis:

	Fixed carbon	Vol. matter	Ash	Moisture	B. t. u.
Lignite—Texas	25	34	8	33	11,250
Slack—McAlester, Oklahoma	47	33	14	6	12,630
Slack—Southern Kansas	45	27	20	8	11,580

Data from several trials show a furnace and boiler efficiency of about 69 per cent for lignite, 68 per cent for McAlester slack and 61 per cent for Southern Kansas slack.

The cost of preparing the fuel is given as $1.17 per 2,000 lb. for lignite, $0.34 for McAlester slack and $0.35 for Southern Kansas slack.

Boiler trials using natural gas at $0.125 per 1,000 cu. ft. show a cost of $0.16 for evaporation of 1,000 lb. water from and at 212 degrees; while the average cost when using Southern Kansas slack is $0.12, a saving of 25 per cent in favor of pulverized fuel. A comparison of tests made with lignite, however, does not show any saving in cost, which may be due to the trouble experienced in reducing the high moisture content of lignite.

It may be of interest to state that a carload of front end cinders was placed by accident in the power plant, dried, pulverized and burned without the least inconvenience. No case of fire or explosion has occurred with the use of pulverized fuel. The damp coal stored in the plant prior to preparation has developed spontaneous combustion, but this has occasioned no other precaution than to stop feeding until the hot coal has been removed.

Thorough examination of the boilers at wash-out periods revealed no flaws, cracks or deterioration at any point in the furnace. A thin scale of glaze about ¼ in. thick covered the entire brickwork, but with no accumulation of slag. Baffles and bridges are intact after 98 days service, and indications are that the walls with pulverized fuel will outlast those with other methods of firing. It has been demonstrated that pulverized fuel is an efficient and successful fuel for stationary boilers.

The Missouri, Kansas & Texas also reports the equipping of a ten-wheel passenger locomotive during the latter part of 1916, the general design of the fuel feeding equipment being similar to that of Delaware & Hudson locomotive.

The principal dimensions of the locomotive are as follows:

Cylinders (in.)	21 by 28
Tractive power (lb.)	29,155
Weight on drivers (lb.)	138,000
Driving wheels (in. diameter)	72
Total firebox heating surface (sq. ft.)	160.4
Total boiler heating surface (sq. ft.)	2,498
Superheater heating surface (sq. ft.)	500
Boiler pressure (lbs. per sq. in.)	200

This locomotive was first equipped for burning Texas lignite, but when it went into service, Kansas slack analyzing in pulverized form from 3 to 8 per cent moisture, 22 to 24 per cent ash, 4½ to 5 per cent sulphur and about 10,650 B. t. u. was substituted. This necessitated a change in the arrangement of the refractory material in the furnace, which change has now been made. Locomotive is now operating in local passenger service burning the Kansas slack. On runs which require the use of from 5 to 5½ tons of Kansas modified lump grade of coal when fired on grates, about 4 tons of pulverized slack is burned without smoke, sparks, or cinders, and maximum steam pressure maintained.

After several recent runs approximating a total of 520 miles with this low grade coal an examination of the tube sheet showed it to be entirely clean of any honeycomb and with no cleaning off from the time this mileage commenced.

Development on the Santa Fe.—The Atchison, Topeka & Santa Fe reports it is investigating the merits of pulverized fuel for locomotives. (See *Railway Mechanical Engineer*, April, 1917, page 187.)

The committee hopes to present a full report on the results of these tests at the next meeting.

Development on Foreign Railways.—The only applications of interest that have been brought to the attention of the committee are those of Central Railway of Brazil and the Swedish State Railways.

The Central Railway of Brazil, after considerable investigation of the pulverized fuel burning locomotives in this country, decided to equip its locomotives for burning fuel in this form. The burning equipment is to be practically a duplicate of that which was installed on the Delaware & Hudson Consolidation locomotive.

The Swedish State Railways have been experimenting with powdered peat, there being no coal deposits in that country. The results of the experiments have been so satisfactory that the railway directors recommended an appropriation of $350,000 for the installation of facilities for producing sufficient powdered peat to supply all the locomotives on one of the state railways.

The heat value of the peat was 7,740 B. t. u., as compared with 12,600 B. t. u. for the coal, it having been determined that 1.45 lb. of powdered peat would produce the same amount of steam as one pound of the British coal. Firebox temperatures of 3,040 deg. F. were obtained with the powdered peat, as compared with 2,750 deg. F. with the coal. The smokebox temperatures averaged somewhat less with the powdered peat, but a higher degree of superheat was obtained with it than with the coal. The efficiency of the boiler figured 73 per cent for powdered peat and 65 per cent for the coal.

The report is signed by: W. L. Robinson, chairman; H. T. Bentley, W. J. Bohan, H. B. Brown, M. C. M. Hatch, R. R. Hibben, D. R. MacBain, J. H. Manning, H. C. Oviatt, John Purcell and L. R. Pyle.

DISCUSSION.

Pulverization is the only means of utilizing lignite which is found in great quantites in the western section of the country, and affords a means of obtaining a cheap fuel with a high heating value. At present coal is hauled long distances to sections where lignite is available and the long hauls would be eliminated if lignite were used. In some sections of the west, the oil supply is becoming exhausted and pulverized lignite will provide cheap fuel for these districts. The advisability of pulverizing bituminous coal for locomotive use was questioned. Doubt was expressed as to the possibility of reducing the time engines were held at terminals as much as was stated in the paper and the possible reduction in the size of exhaust nozzles was also questioned. Some improvement might be secured by special designs for fire boxes to secure better combustion in burning pulverized coal. The principal trouble now experienced on locomotives burning powdered coal is the formation of clinker on the tube sheet. This may be due to moisture coming from leaks or in the coal itself, or it may be due to tar or to sulphur and iron in the coal. The committee was asked to devote special attention during the coming year to means for eliminating clinkering on the tube sheet.

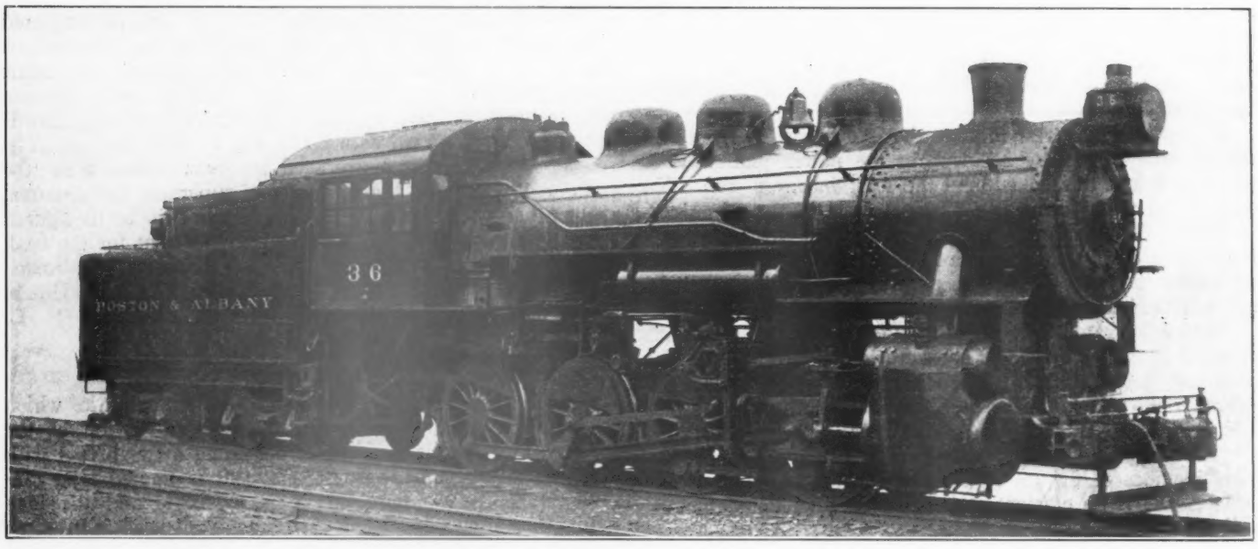
STEEL FOR CARS AND LOCOMOTIVES.—The United States Chamber of Commerce is interesting itself in the railroads' need for steel. Weddill Catchings, chairman of the Committee on Co-operation with the Council of National Defense of that association, has issued the following statement: "When the production of railroad cars and locomotives is interfered with because necessary steel is going to industries producing pleasure automobiles, steel furniture, buildings for amusements, etc., the situation cannot continue."

CONVERSION OF CONSOLIDATION TYPE LOCOMOTIVES TO EIGHT-WHEEL SWITCHERS

BY F. J. CARTY
Mechanical Engineer, Boston & Albany, Boston, Mass.

Because of heavy freight traffic in the early part of 1916, and because of the increase in train loads, it became apparent that more powerful switching locomotives were required on the Boston & Albany to handle quickly and efficiently the heavy trains brought to terminal yards by Mallet and Mikado type locomotives. In order to switch such trains properly, it is essential that the switching locomotive have a tractive effort at least equal to that of the road locomotives, and the design should permit of quick operation.

A study of the governing conditions convinced us that it would be difficult to develop a six-wheel switcher which would satisfactorily meet the requirements of the service, and it was therefore decided to build switcher of the eight-wheel type having adequate tractive effort without excessive axle loads. As the cost of materials entering into the construction of locomotives was much above normal prices, we found that a considerable saving could be made by converting Consolidation type locomotives into 0-8-0 type switchers.



Boston & Albany Eight-Wheel Switcher Converted from a Consolidation Type Freight Locomotive

The Consolidation locomotives selected were built in 1901, having a tractive effort of 37,190 lb., 20-in., by 32-in. cylinders and 57-in. driving wheels, and experience had shown that the locomotives were not sufficiently powerful to haul a satisfactory tonnage at scheduled speeds in freight service. Upon inspection, it was found that the frames, rods, driving wheels and many minor parts could be utilized in the reconstruction of the locomotives into an 0-8-0 type. The mechanical department was authorized to prepare designs and begin the work of converting 12 locomotives at West Springfield shops.

The elimination of the engine truck with the consequent increase in the weight on driving wheels made it necessary to provide larger cylinders to obtain a properly proportioned and efficient locomotive. It was decided to apply 23-in. by 32-in. cylinders of the outside steam pipe design, a new boiler with a superheater, outside valve gear and Ragonnet power reverse gear. A practically new, modern switching locomotive was thus produced adaptable to the requirements of service prevailing in Boston & Albany terminal yards. In order to utilize as much as possible the old frames and running gear, the driving wheel base was maintained at 17 ft., but it was necessary to cut off the front section of the frames because of the removal of the engine truck.

These changes in design made it necessary to recalculate the "live" loads in order to bring the center of gravity of the locomotive in a vertical plane midway between the main and intermediate drivers. It may be of interest to outline the method followed to determine the correct position of the boiler.

The "dead" loads, consisting of driving wheels, engine truck wheels, boxes, cellars, bearings, axles, crank pins, eccentrics and the proportionate weights of main and side rods, were assumed to be concentrated at each axle. One-third the weight of the main rod, and one-half the weight of the eccentric blades were assumed to be carried at the main driving wheels. Subtracting the dead loads from the known distributed weights gives the live load at each wheel.

By taking any convenient point as an axis of moments, such as the center of the engine truck axle, and multiplying the live load at each wheel by the distance of the load from the selected axis, the location of the center of gravity of all parts of the locomotive, other than those considered as dead loads, is determined. The next step is to find the location of the center of gravity of the live load with the engine truck removed, making the proper allowance for increased weight due to the larger cylinders, the outside valve gear, the superheater, changes in the smokebox and bumper castings. In this computation, the entire weight of the superheater header and units was considered as concentrated at the front flue sheet. The center of gravity of the live load was 6 in. ahead of the plane midway between the main and intermediate driving wheels.

After determining the location of the center of gravity of the live load with engine truck removed, the weight of the boiler with two gages of water, and the center of gravity of the boiler and water should be found. In this calculation it is convenient to divide the boiler into four parts; the smokebox, first course, second course, and firebox. The weight of each of the four sections is assumed to be concentrated at the geometric center of each section. By taking moments about any convenient axis, such as the smokebox front, the center of gravity of the boiler and water may be calculated and it will then be possible to determine the weight and location of the center of gravity of what we may term the machinery of the locomotive.

Knowing the weight and location of the center of gravity

of the boiler and of the machinery, we can at once compute the number of inches the boiler must be moved toward the rear in order to bring the center of gravity of the locomotive midway between the main and intermediate wheels. It is important that this be done in order to insure correct distribution of the load between the four pairs of driving wheels, and it is also essential that special attention be given to the design of the equalizing rigging. We have used the latest type of equalizer arrangement with transverse equalizer at the forward end of the locomotive.

It was found that in order to compensate for the removal of the engine truck and the changes outlined, the boiler should be moved toward the rear 14¼ in. and the new boiler was designed to meet this condition.

Owing to the use of outside steam pipes with the new cylinders, a new single rail front frame section was necessary on the converted locomotives. The old frames were cut at the front pedestal jaws and the new cast steel front sections welded on by the thermit process. The frames are unusually well re-enforced, and on account of the increase in power of the eight-wheel locomotive, as compared with the Consolidation locomotive, we considered it advisable to apply a stronger type of pedestal binder, replacing the old thimble type by cutting off the lower part of the pedestals, and filling up the bolt holes with the aid of the electric welder. A new cast steel front bumper beam has been applied and the foot plate is particularly heavy to compensate, in part, for the increase in weight at the forward part of the locomotive. The driver brake cylinders are supported in a vertical position from the guide yoke crosstie and new cylinder levers, proportioned to give correct braking power, are connected to the old foundation brake rigging. A wide steel cab substantially braced replaces the old wooden cab, and the air reservoirs and running boards are securely supported by cast steel brackets, bolted to the boiler.

The boiler is of the straight top radial stay type, having a full installation of Tate flexible bolts, Security brick arch, and a single 14-in. by 20-in. fire door opening, designed for a pneumatically operated fire door of the Franklin butterfly type. There are four combustion tubes in each side of the firebox. As the two rear tubes on each side come within the cab, we have protected the enginemen by covering over the outer ends of the combustion tubes with 2-in. pipes which extend down to and through the cab running board and are arranged so that the air flowing into the combustion tubes is drawn from outside the cab.

Two sand boxes are located on top of the boiler and the locomotive has the usual specialties : Pneumatic sanders, bell ringer, cylinder cock operating mechanism, Hancock type E injectors, Consolidated safety valves, Everlasting blow-off valve, King type packing and a special type of exhaust pipe which modifies the noise of the exhaust. The Radial buffer is provided between the locomotive and tender to facilitate the removal of drawbar for inspection and the power reverse gear is supported from the boiler by means of brackets made up of boiler plate.

The tender tank has been remodeled so as to interfere as little as possible with the view of the enginemen when the locomotive is operated with tender leading. The longitudinal channel sills of the tender under frame have been reenforced by plating and new cast steel end sills have been applied. The coupler and pocket at the rear of the tender are of the latest Sharon type, with a 3-in. pin.

The first of the 12 locomotives to be converted has been in service a short time, and the results obtained are entirely satisfactory. The locomotive handles the cars without difficulty, starts and stops quickly, and the performance is fully up to expectations. The cost of labor and materials has advanced rapidly since work was begun, and while therefore the cost of converting the locomotives may exceed the estimates, the apparent saving compared with the cost of new locomotives of similar type is greater than was estimated on account of present abnormal prices.

A comparison of the principal characteristics of the Consolidation and the eight-wheel switcher is given below:

	Consolidation	Eight-wheel switcher
Cylinders, diameter and stroke, in.	20 in. by 32 in.	23 in. by 32 in.
Steam pressure, lb. per sq. in.	195	180
Tractive effort, lb.	37,190	45,440
Grate area, sq. ft.	50.3	50.3
Heating surface, sq. ft.	3,135	2,174
Superheating surface, sq. ft.	None	472
Tubes, number of 2-in.	359	175
Tubes, number of 5½-in.	None	26
Tubes, length	16 ft.	16 ft.
Superheater	None	Schmidt
Valve gear	Stephenson	Baker
Reverse gear	Hand-operated	Ragonnet
Wheel base	25 ft.	17 ft.
Weight drivers, lb.	163,000	193,000
Factor of adhesion	4.4	4.25
Tender, tons coal	10	10
Tender, gallons water	5,000	6,000

RAILWAY EFFICIENCY AND THE WAR*

BY DANIEL WILLARD

President, Baltimore & Ohio, Chairman Advisory Commission on National Defence

One of the first problems requiring serious consideration after the declaration of war was the matter of transportation, and I feel that it is a great credit to the railroads of this country that in just five days after the Congress had declared war, men representing the 175 principal independent railroad companies in the United States assembled in Washington, and, after listening to a presentation of the situation, they voted unanimously then and there, and signed papers confirming their action before they left the city, giving to a small committee of five men, selected by these railroad representatives, full power to control the operation of all the railroads in the United States during the period of the war in order that the railroads might thereby be in a position to respond immediately and as a unit to any demand made upon them by the President in the interest of the general situation.

Nothing of the kind was ever done before by any industry, so far as I know, in this or any other country, and the railroads were the first to do it—and remember, only five days after war was declared. We went from a system of 175 separate and independent companies competing with each other into one nationalized system under the control of five of the ablest railway men in the country. Why? In order that we might best serve our country and so best *help to win the war.* That is why it was done. No other reason in the world would have induced those executives to turn over their properties to be run as five men might dictate.

The committee of five men are sitting constantly in Washington, in effect with a map of the United States before them, on which is a railroad system 265,000 miles in length, with all ownership names wiped out. They are no longer thinking in terms of C. B. & Q., North Western, Pennsylvania, or anything of that kind. They realize that they are faced with the problem of seeing that the necessary transportation service of the United States is performed.

The importance of the railroads in a time of war is constantly illustrated. Marshal Joffre, when he was in Washington a short time ago, said something like this, as near as I can recall:—"The Battle of the Marne was won by the railroads. Without the railroads it would never have been possible to bring up the supplies, to provide the armies with the munitions, and all the things necessary to carry on the battle. The railroads won the Battle of the Marne." That was the statement made by the Hero of the Marne, one of the greatest soldiers of the present day.

RAILWAY SITUATION IN RUSSIA

Professor Lomonossoff, a high official of the Russian transportation system, is in this country now. A few days

*From an address delivered to the officers of the Baltimore & Ohio at Deer Park, Md, June 29, 1917.

ago he also made the statement that unless they can have improved transportation facilities in Russia, it will be impossible for them to vigorously carry on the war. I am going to take time to tell you briefly just what he said about the railroad situation in Russia.

He pointed out for instance, that Petrograd—which is, we will say, the Pittsburgh of Russia—had formerly obtained its coal supply from England. Russia is not so richly favored by Nature with coal deposits as is the United States, and the only deposit of any considerable size is in Southern Russia near the Caucasus, 1,400 miles from Petrograd. They are now obliged, because of that situation, to haul roundly 1,500 cars of coal north from the Caucasus each day, several times more than they had to haul in times of peace. That, in itself, was pretty big trasportation problem in a country so sparsely provided with railroads as Russia.

Furthermore, the blocking of the Archangel route virtually made Vladivostok the front door of Russia, and where formerly equipment and other things much needed came in by a much shorter haul, now those same materials, if they get there at all, must come via Vladivostok and be hauled by rail 6,000 miles before they reach Petrograd. Some of that railroad—considerable of it, in fact—is single track. I want you to know this because you gentlemen have got to play an important part in the winning of this war. I hope I will succeed in making that clear to everyone of you. I have no doubt that you have appreciated it from the first, but it will do no harm to repeat, that every man in this room has got to *help win this war.* Today Russia wants 2,500 locomotives just as soon as they can be obtained and 40,000 cars. Why should we be interested in that? For this reason; for this very, very good reason. It is estimated that the Germans have some two and a half millions of their troops on the Eastern front. If Russia should be forced to make a separate peace with Germany, and she might be compelled to do so—not because of the change of government, because it is believed that that change has helped the situation—but suppose Russia should be unable to get supplies, to get food, to get ammunition, to get guns, and all the other things necessary for her army—she might have to quit whether she wanted to or not, and if Russia should make a separate peace with Germany those two and one-half million Germans that are now facing the Russian Army would be released and would be moved to the western front facing France and England, and that is the exact number, I suppose, of additional men which we would have to send over to oppose them. In other words, it may mean two million more of our young men to France if Russia is unable to meet her transportation problem satisfactorily.

"BE CAREFUL OF YOUR POWER"

Now, why do I mention all this? For this reason: the combined output of the locomotive shops in this country is about 5,500 a year. Russia wants a thousand engines before the first of January, and at least 2,000 next year. England and France require from 1,000 up to as many as we can give each year. But suppose we give Russia 1,500 next year and England and France 1,000? That is nearly one-half of the average total locomotive output of this country. We also need more power on our railroads, but shall we sit down and hold on to everything we have and see Russia forced to a separate peace? Shall we, in order to make our own task somewhat easier, to meet a situation that is undoubtedly pressing here, hold on to all the new engines we can build, facing the possibility that because of such action we may have to send 2,000,000 more of our young men to the battle line? Or shall we say to the builders, "You send the engines that Russia wants, you send the engines that France and England want, and we by additional effort will undertake to carry the greatly increased burden put upon us, with what we already have"; that is why I ask you to be more careful of your power, to keep it in better shape, to get more out of it, to try constantly to do more with what you have. Not because we do not want to spend money, although that is a good reason, but because we want to send every available car and engine to our Allies so that on that account we will be called on to send fewer of our young men. I want you to think of that seriously.

THE RAILROAD'S PROBLEM

The railroads will not be able, no matter how hard they try, to carry all the freight that will be thrown upon them during the war, and this is why: They were measurably well equipped to perform the service of the country before the war began. As a matter of fact, for a period of some seven or eight years there was nearly always a surplus of anywhere from 50,000 to 350,000 freight cars. It cannot be said that the railroads were not fairly equipped to do the work required of them when the war began. Since then, and particularly within the last six months, we have done considerable toward increasing the crop average. Our shops and factories were working feverishly day and night before we entered the war, making munitions for our Allies. Since then this government has appropriated two billions of dollars for the necessary supplies for its own army, superimposed on what we were already undertaking to do.

In addition to that, many boats on the Lakes which formerly carried a large volume of business east and west have been taken off, sent down through the Welland Canal and are now in Trans-Atlantic service. The boats that formerly ran up and down the Pacific Coast, carrying coal from Vancouver to southern points, have been taken off to be used as mine-sweepers, patrols and in transport service for the Navy. In the east a considerable number of boats that formerly were in our Atlantic coastwise service have been taken off. The business they formerly carried is now being done by the railroads. Not only have boats been taken off, but insurance rates on the water are so high, because of the submarine menace, that much of the business that might go by boats is now going by the railroads, and still further, the boats that formerly ran through the Panama Canal are now in other service. All that puts additional work upon the railroads, and that they have responded to the situation as well as they have I think is a great credit to everyone engaged in the railroad calling. Now, for the reasons given, the railroads will not be able to carry all the freight that may be offered. That is one of the things that I wish you gentlemen to understand, so that you will be able to help the public understand—that part of the public with which you come in contact.

The railroads will probably be able to carry all of the food stuffs necessary. They will carry the necessary coal and munitions, and they will carry the steel to make ships, *all of the things necessary from the standpoint of winning the war,* and this will not exhaust their capacity. But let us say that it will take 75 per cent of their capacity to perform service of the kind mentioned, leaving 25 per cent of the capacity for the ordinary business of the country.

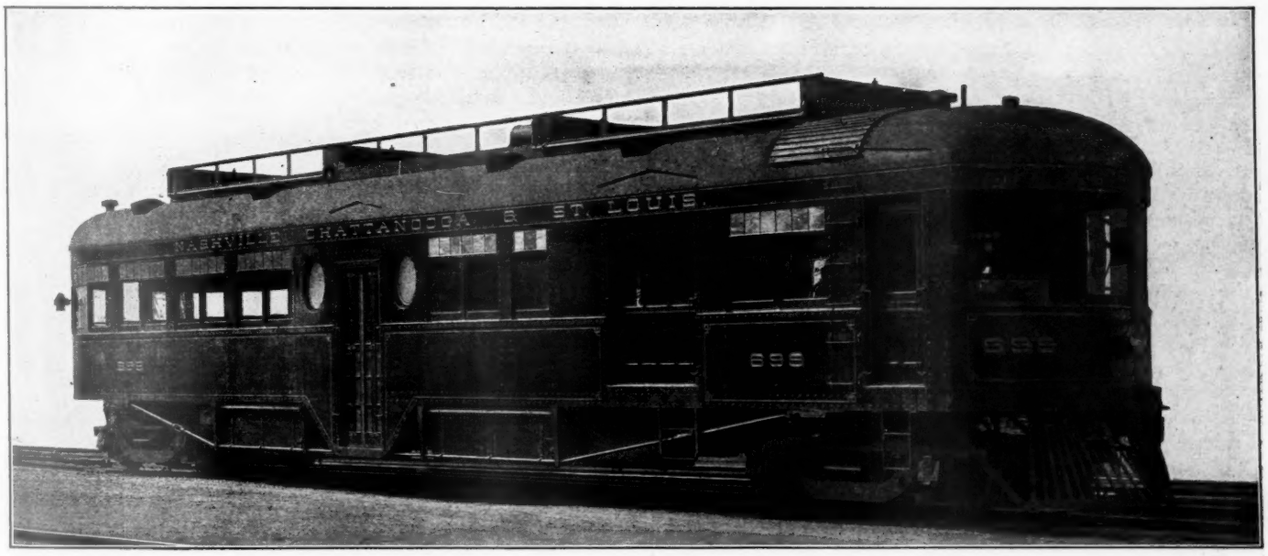
Now you men who come in contact with the public must explain the situation to them, you must say to them that there is *nothing* in this world so important to you, or to them, or to anyone interested in this country as *the winning of the war.* This is the only test we have: *"Will the thing under consideration help win the war?"* If so, it has our support; if not, so long as the war continues, we are not interested in it. I hope you men, because of what I say, will have a little better understanding of the situation when you leave here than have many who are living in the interior, and it is your duty, and your privilege, too, to tell them what the situation is as you understand it, so that they can co-operate and help in what we are all trying to do. My own experience makes me believe that they will accept your suggestions and you will find co-operation instead of complaint.

OIL-ELECTRIC MOTOR CAR

A new type of self-propelled car which is operated by a 150-hp. oil engine connected to a generator in connection with a storage battery having a rated capacity of 438 ampere hours at the five-hour rate, has been built for the Nashville, Chattanooga & St. Louis by the Electric Car & Locomotive Corporation, 165 Broadway, New York City. This car is the most powerful self-propelled car yet constructed, and with the combination of the generator and storage battery a large reserve of power for peak loads is obtained. The car was invented by Ralph H. Beach, and it is designed to take the place of steam train service on branch lines and small railways where such service is unprofitable. It is claimed that this car will operate at from one-third to one-fifth of the present cost of steam operation. From tests it has been found that the car will run 2½ miles per gallon of kerosene oil, and 50 miles per gallon of lubricating oil. Its rated speed is 45 m.p.h., and the rated acceleration is 8 m.p.h. per second. Its service is, therefore, not limited to branch line service, but it could be used to advantage in high speed interurban work and between divisional points on railways. This car is to be used between Nashville and Lebanon, Tenn., a distance of 32 miles. On this run there is a short grade of 2.25 per cent and a grade a mile long of 1.7 per cent. Three round trips will be made per day with the car.

The power plant in the car is of particular interest. A standard four-cycle, eight-cylinder, 150-hp. oil engine of the marine type is direct-connected to a 100-kw. differential compound wound, 250-volt d.c. generator, running at a constant speed of 1,000 r.p.m. This engine will burn either kerosene or fuel oil, and is so arranged that no carburetors are necessary. The oil is fed to the cylinders in a gasified state. From the storage tank the oil passes to a gas generator, which converts the liquid fuel into a permanent fixed gas. This generator is located in the muffler of the exhaust, thus absorbing the waste heat from this source for gasifying the oil. From the generator the gas passes directly to the engine cylinders, being mixed with air in the proportion of one part of gas to six parts of air where the kerosene is used. This mixture burns in the cylinders without smoke or any carbon deposit on the walls of the cylinders. The gas generator has no moving parts and no deposits of carbon, tar or by-products of the oil are found to remain in the generator.

The storage battery is suspended underneath the car body and operates in parallel with the generator. It is characteristic of a storage battery that as the load increases the voltage declines and as the load declines the voltage rises.



Beach Motor Car Equipped with an Oil-Electric Unit and Storage Batteries

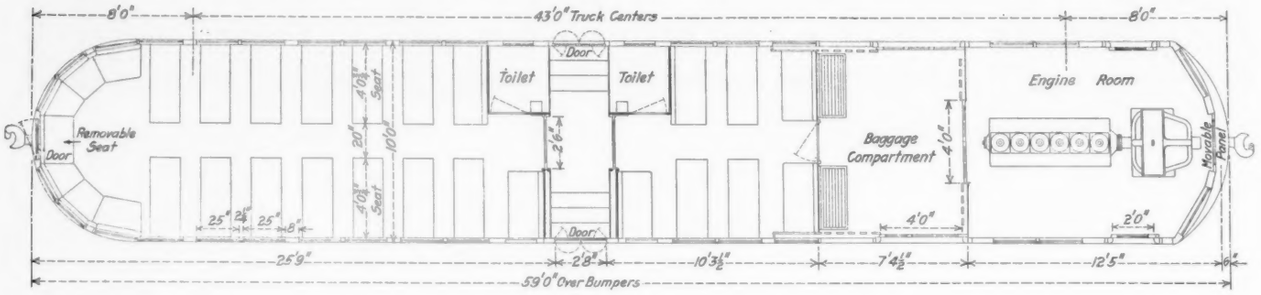
The generator is so constructed that it will automatically coincide as to voltage with the battery. In a generating plant constructed in this manner, the generator will deliver current up to its capacity, and at the same time will work in unison with a storage battery, which by itself will supply any excess of current that the load may require. This battery is capable of delivering 400 hp. for 5 minutes, 210 hp. for 15 minutes, 93 hp. for one hour and 30 hp. for 5 hours. This power in addition to the 150 hp. developed by the generator gives the car an abundant amount of power for acceleration and for use in working over heavy grades.

With this arrangement the engine works at nearly full load constantly, therefore getting its maximum efficiency. All power required above the capacity of the engine is furnished

by the battery, and all power generated by the engine, not required to drive the car, charges the battery. The battery furnishes convenient source of energy for starting the engine, lighting the car and driving the auxiliary apparatus. It also furnishes a complete and separate source of energy in case of failure of the engine to perform its work, having sufficient capacity to operate the car about 35 miles.

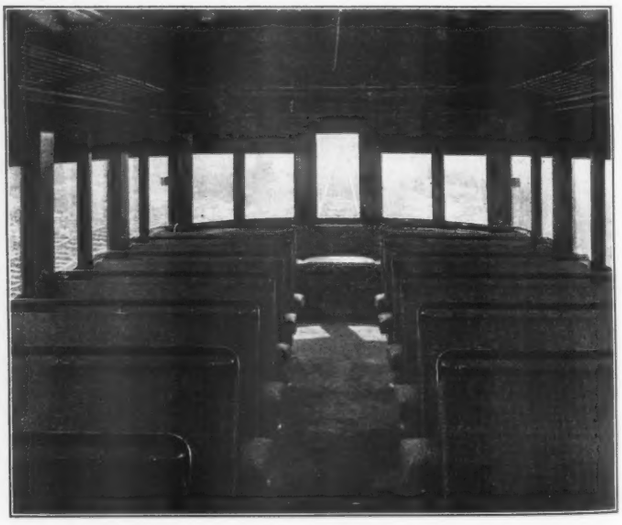
The body of the car is made of steel with the exception of the interior finish, sash and doors, which are mahogany. The car weighs 113,000 lb., is 59 ft. long and is divided into four compartments, as follows: Engine room 12 ft. 5 in. long; baggage room 5 ft. 5 in. long; smoking compartment 10 feet; main passenger compartment 25 ft. 6 in. The entrance to the car is between main passenger and smoking compartments. It is provided with folding doors and a trap door to cover the steps when the door is shut. In addition to the side entrances there is an emergency exit at the end of the car, a sliding door with a drop window at each side of the engine room and 4 ft. sliding doors in the baggage compartment. The car has a total seating capacity of 75 people, the baggage room being provided with folding seats for four persons, the smoking compartment has a capacity of 18 persons and the main passenger compartment has a seating capacity of 53 persons. Each passenger compartment is fitted with a lavatory, basket racks, Pantasote curtains, incandescent lights and stationary seats. The car is fitted with an M.C.B. drawbar and incandescent headlight. It is heated with hot water from the engine, which is by-passed when it is not wanted.

The car is provided with two four-wheel trucks made by the Baldwin Locomotive Works of the equalized high speed type. The trucks have a 7 ft. 3 in. wheel base and are provided with 33-in. M.C.B. rolled steel wheels. The journals are 5 in. by 9 in. The type of control used on this car is the Standard Westinghouse H. L. series-parallel type, used for single or train operation. Four standard 250-volt box frame railway motors, having a horsepower of 75 each, are mounted one on each axle. They are inside hung and are equipped with standard gears and cases. The Westinghouse straight and automatic air brakes for single and trailer operation are used, as well as the hand brake. Multiple tube type radiators mounted on the roof with forced circulation are used to cool the water from the oil engine. There are two oil tanks having a capacity of 140 gallons each. Air operated whistles, gong and sanders are furnished with the car.



Seating Arrangement of the Beach Oil-Electric Motor Car

Interior View of the Forward End of the Beach Oil-Electric Car



Passenger Compartment of the Beach Oil-Electric Car

The following are the estimated figures for the cost of operating this car. The amount, of course, will vary with the service required and upon the scheduled speed, distance between stops, grades, etc. These figures, however, are prepared covering average conditions.

	Per Mile
Wages	$0.0745
Fuel and lubrication	0.0400
Repairs and supplies	0.0350
Depreciation	0.0385
Total cost	$0.1880

Virginian 120-Ton Flat Bottom Coal Car Built by the Virginia Bridge & Iron Company.

A Virginian 120-Ton Coal Car

Revenue Load 76.4 Per Cent of Total Load; Unique Transom Design; Articulated Six-Wheel Trucks

BY B. W. KADEL

ONE of the four experimental 120-ton gondola cars which are being constructed for the Virginian Railway by various builders, has recently been completed and delivered by the Virginia Bridge and Iron Company, Roanoke, Va. The design of this car demonstrates certain special features of construction of this class of equipment. It is built for use in bituminous coal carrying service between the West Virginia fields and the tide-water terminal of the Virginian at Sewalls Point, Va., there to be handled over the road's car dumper.

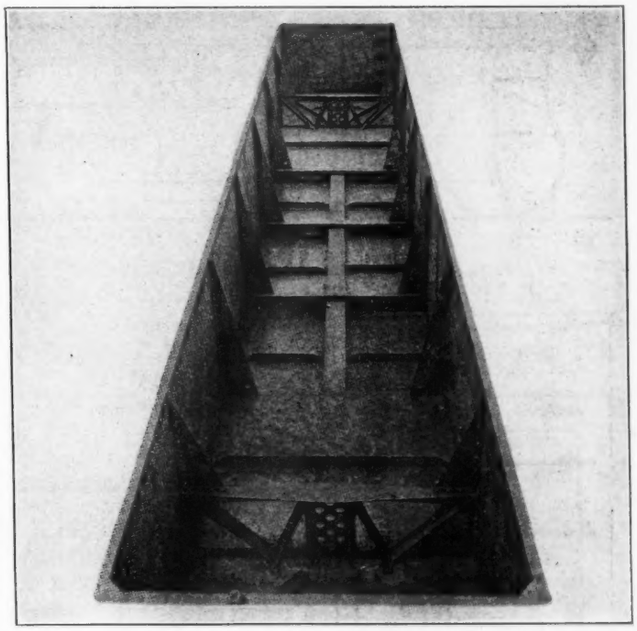
The principal dimensions of the car are as follows:

Length inside	50 ft.
Length coupled	53 ft. 7 in.
Distance between truck centers	37 ft. 4¾ in.
Width inside	9 ft. 8½ in.
Width over all	10 ft. 3½ in.
Height of sides above rail	11 ft. 1½ in.
Height of sides inside at ends	7 ft. 3¾ in.
Volume level full	3,785 cu. ft.
Volume with 30-deg. heap	4,422 cu. ft.
Truck wheel base	9 ft.
Truck weight	16,350 lb.
Capacity	218,000 lb.
Weight	73,900 lb.
Ratio of revenue load to total load with 10 per cent overload	76.4 per cent

The car body is of plate and angle construction with Carnegie cross-tie sections for side stakes and end plate stiffeners. To provide for corrosion the minimum plate thickness is ¼ in., and no angles of less than ¼-in. stock have been used. Heavier stock is used wherever needed.

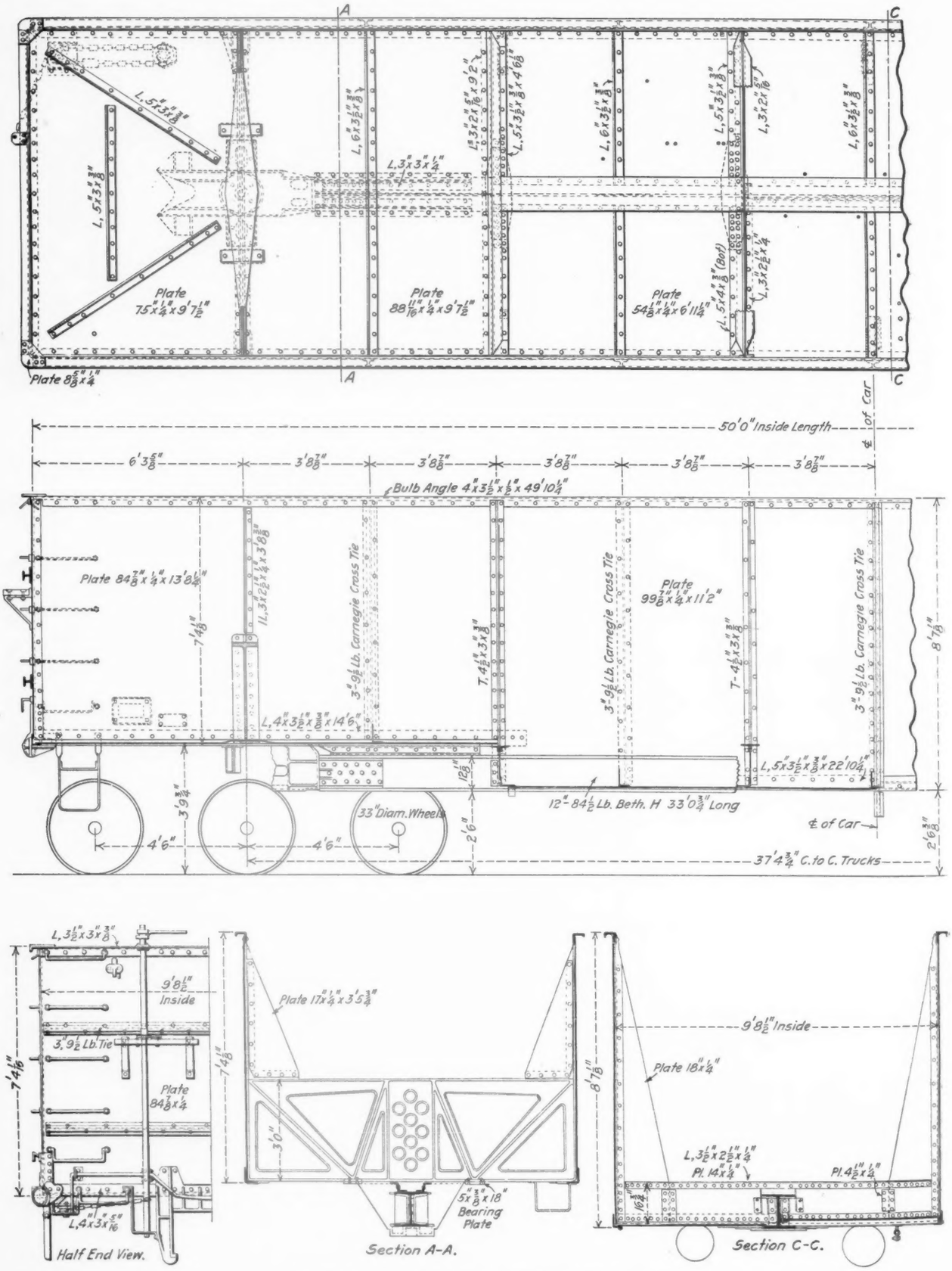
The principle of the design is that the weight of the lading actually be transferred to the sides of the car, the integrity of the center sill as a draft member being maintained. The center sill is a Bethlehem 12-in. 84.5-lb. H-section and extends not quite to the bolster at either end of the car. The ends of the center sill are milled and are attached to steel castings, which form a portion of the National Malleable Castings Company's radial draft gear, so that the buffing forces are delivered to the center sill, not through the rivets, but as direct loads upon the ends of the sills. The center plates are integral parts of these steel castings.

The ratio of stress to end strain for this sill is .057, a factor well within the recommendations of the M. C. B. Association. In addition to this there are no open holes or cuts of any description in the sill, it is well braced and stayed both vertically and horizontally and does not carry any of the weight of the lading, thus eliminating vertical bending.



Interior of the Virginian Coal Car Showing the Unique Steel Transom Castings

To prevent the center sill from receiving bending stresses

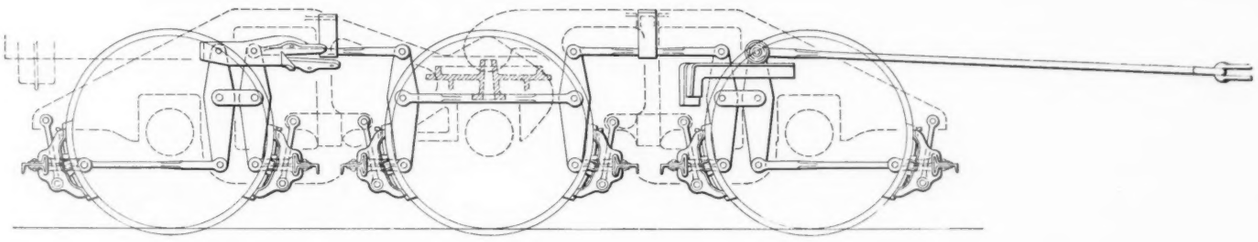


Elevation, Plan and Sections of Virginian 120-Ton Car

of any moment from the lading, three plate girder diaphragms are provided to carry the load out to the side plate girders. These have the compression members passing continuously over the center sill and the bottom or tension members passing under the sill. At the outer diaphragms the floor line of the car is dropped down to the plane of the lower face of the center sill, thus increasing the capacity of the car and lowering its center of gravity.

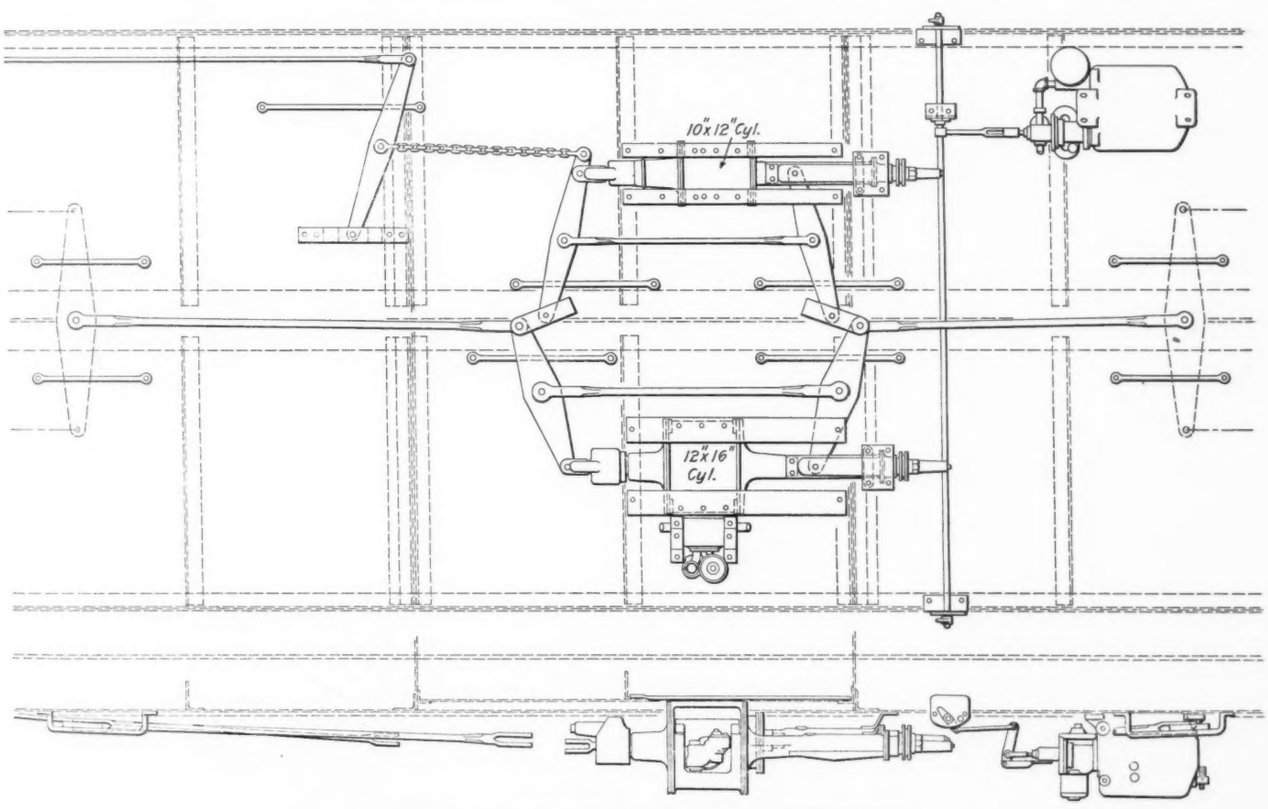
The sides are constructed of ¼-in. plates with a bottom chord of angle section and a bulb angle for the upper chord. From the depressed portion of the floor to the ends of the car the size of the bottom chord angle is reduced, as its load is less nearer the bolsters. The side plates are also cut away here in line with the floor over the trucks, not only to eliminate unnecessary metal, but to give an unhindered view for the inspection of the trucks. No cross-ties are used, the sides wing plates support the car and prevent the sides from bending in when the cradle is rotated. The ends of the car are stayed against bulging by means of two Carnegie cross-tie sections extending from side to side. Because of the excessive depth of the car at the ends inside ladders are supplied.

The sides of the car are carried by the body bolsters which are of novel construction. They are integral steel castings, located above the floor of the car within the coal space, and are shaped not only to give an economic and advantageous disposition of the metal for the various conditions of load applications, but at the same time to offer no obstruction to the coal in dumping. Wing plates extend upward from the outer ends of the bolsters to stay the sides of the car. The bolsters are a product of the American Steel Foundries.



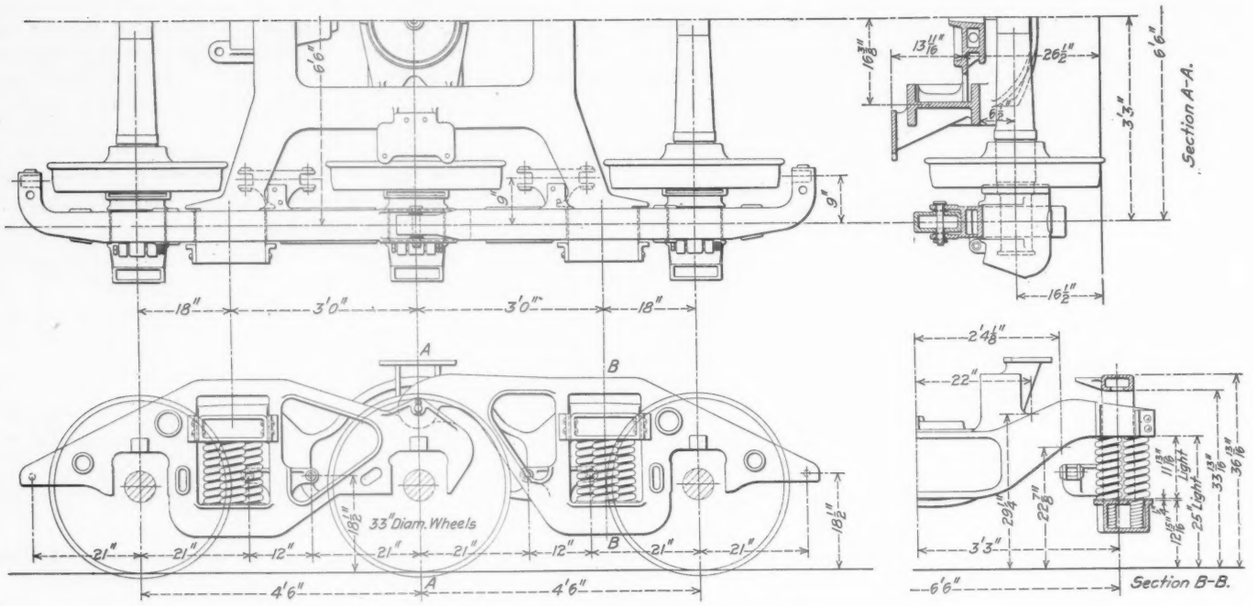
The Clasp Brake Rigging

The floor is stiffened between the diaphragms with angles. The diagonal angles for stiffening against poling are located being stiffened by means of wing plates which extend between the diaphragms and the inside side stakes. Between the diaphragms are located the stakes on the outside of the car so that they bear against the blocking on the cradle of the car dumper. The top angle, grab irons, etc., are thus protected, while the alternating inside stakes with their stiff above the car floor to clear the brake rigging of the trucks.

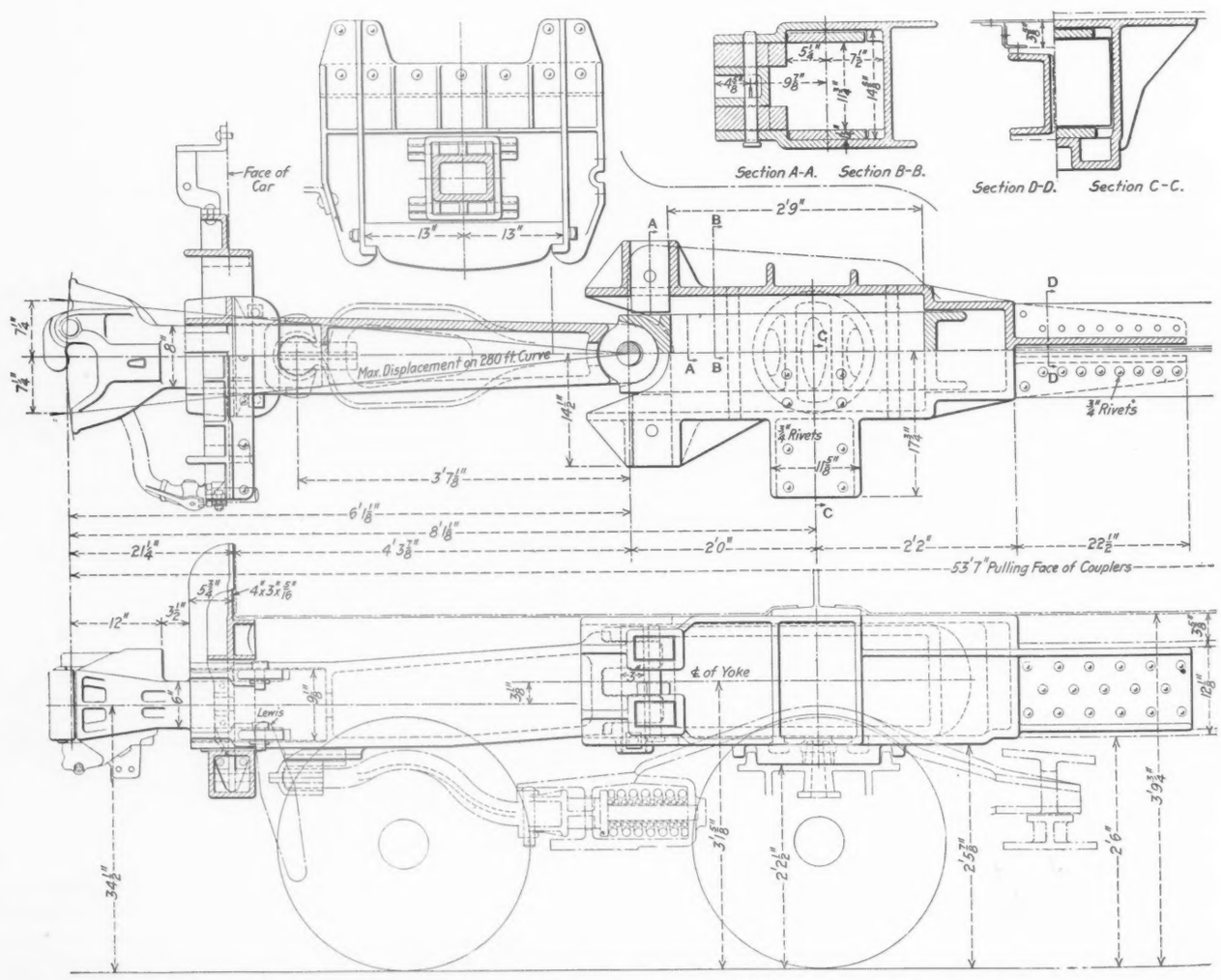


Arrangement of the Empty and Load Brake Connections

Because of the great weight of the car it is necessary to provide definite jacking points specially designed to take care of this operation. Two jacking blocks are provided at each corner of the car, the one being under the end of, and in reality a part of, the cast-steel body bolster, the other be-



General Arrangement of the Lewis Truck

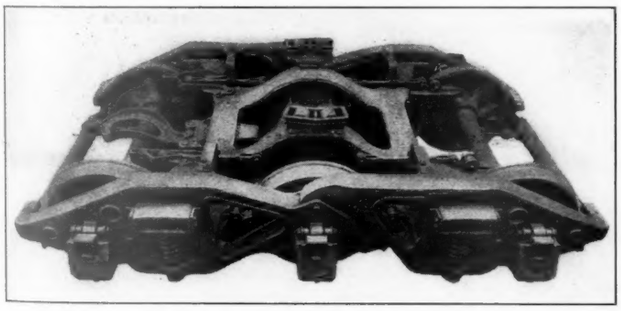


The National Radial Draft Gear Applied to the Virginian 120-Ton Coal Car

ing a part of the corner poling pocket. Either of these blocks will support the load of that corner of the car, so that the car can be jacked up at one of these points and stooled at the other. The jacking face on the bottom of the push pole pocket bears directly against the bottom end of the corner angle of the car body, and serves to strengthen the push pole pocket and the corner of the car. The push pole pockets also have bracket portions which extend out and engage stops on the cradle of the dumper, should the overhead clamps for any reason fail to hold the car when in inverted position. This feature is used on other equipment of the Virginian Railway. Wooden planks are set into the outline of the center-sill section to present a smooth face for the sliding of the coal and prevent its hanging up when dumping the car. These are held in place by means of removable stops upon the diaphragms, and are accessible from the outside. No open holes are left in the center sill for the purpose of securing this planking.

The trucks for this car are of the Lewis Articulated* six-wheel type manufactured by the American Steel Foundries, and are equipped with McCord pressed-steel journal boxes of the Vulcan type and Davis cast-steel wheels. Each truck weighs 16,350 lb. The length of the wheel base is 9 ft. and the height of the center plate is 26½ in. above the rail. The center plates are 16 in. in diameter, and are machine faced. The bolster springs are of extra large capacity. The bolsters are fitted with Stucki Frictionless side bearings of the two-roller type, the rollers being four inches in diameter and four inches long. The axles are M. C. B. Standard with 6-in. by 11-in. journals.

The car is equipped with the Westinghouse Air Brake Company's empty and load brake. A 16-in. by 12-in. load cylinder and 10-in. by 12-in. empty cylinder are used, the latter having a 4-in. preliminary slack take-up piston. The brake is designed to give a braking power of 40 per cent for the empty or loaded car. The trucks have clasp brakes, the arrangement of which has been worked out especially to prevent excessive reaction loads in the side frames. The foundation brake gear and the clasp brakes were furnished by the



The Lewis Articulated Six-Wheel Truck

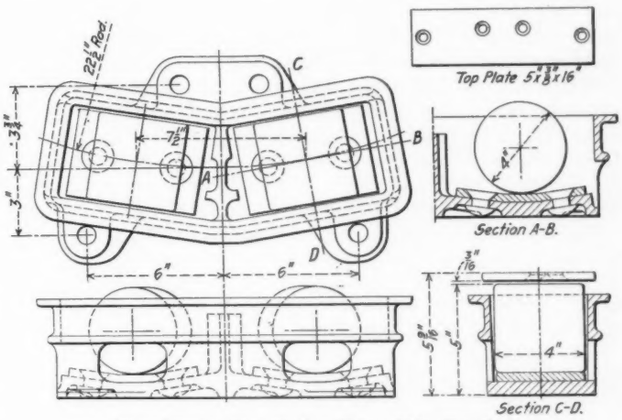
American Brake Company. The Banty ratchet hand brake is used.

The car is equipped with the National Malleable Castings Company's radial draft gear, which is pivoted to the ends of the center-sill construction, and is swung with the truck through the medium of an arm connected with the truck bolster. The draft gears at all times stand approximately tangent to the track and in line with each other, so that in buffing the forces have little tendency to displace the couplers. The coupler heads are specially made with side abutments or stops which allow but a limited movement of the couplers out of line in buffing.

The volume of the car is 3,785 cu. ft. level full and 4,422 cu. ft. including a 30-deg. heap. Its light weight, including the specialties mentioned, is 73,900 lb., of which 32,700 lb. is in the trucks and 41,200 lb. is in the body.

While the car is generally known as of 120 tons capacity, the car in reality is stenciled 218,000 lb. in order that the allowable loads for the 6-in. by 11-in. axles may not be exceeded when the car is given a 10 per cent. overload. On this basis the load per pair of wheels with 10 per cent overload amounts to 52,283 lb., or a load of approximately 49,900 lb. on the M. C. B. 50,000-lb. axle.

The car represents the results of extensive experience and careful study and was worked out jointly by the builders and the motive power department of the Virginian Railway. The aim in the design has been to eliminate as far as possible all useless metal and to this end an especially careful analysis



The Stucki Two-Roller Type Side Bearing

of the known forces and stresses was made. Under the most extreme conditions of loading, the extreme combined stresses have not been allowed to exceed those given in the table, based on 10 per cent overload in the car. As far as possible

STRESS LIMITATIONS OBSERVED IN DESIGN OF VIRGINIAN 120-TON COAL CAR

	Stress, lb. per sq. in.		
	Structural parts	Steel castings	Rivets
Tension	13,000	9,000	.....
Compression	13,000	9,000	.....
Shear	9,000	8,000	8,000
Bearing	.....	.....	16,000

the secondary stresses have been analyzed and allowed for, and it is hoped later to have available for publication the method of calculation for the various portions of this car.

AIR COMMERCE AFTER THE WAR.—At a recent meeting of the Aeronautical Society of Great Britain a paper on "Commercial Aeronautics" was read by G. Holt Thomas, one of the pioneers of aviation in that country. Mr. Thomas said that in his opinion aeronautics would revolutionize the world not only from a commercial point, but also from a humanitarian point much more than it had revolutionized war. He said he was not one of those who thought commercial aeronautics were going to beat out of existence the railroads and other forms of transport, but rather that flying would act as an adjunct to present modes of transport. From a business point of view speed was everything. The airplane would enable a business man to leave London in the morning, go to business in Paris and be home again to dinner. It would take him to Bagdad in a day and a half or to New York in two days. Ceylon would become 2¾ days from London, Tokio 4½, Sydney five, Cape Town 3½, and Vancouver 3. As for the question of cost it would be possible to run a profitable air service between London and Paris at $25 a passenger, a cent an ounce for mails and 50 cents each for parcels of three pounds.

*For a description of this truck as originally designed, see the *American Engineer* for January, 1913, page 35.

Cars in Use Behind the Trenches

A Flexible Arrangement of Narrow Gage Trucks Built for the French Department of Artillery

AMONG the many classes of railway equipment which have been built in America during the war for use in Europe, the special steel trucks built for the French Department of Artillery by the National Steel Car Company, Hamilton, Ont., are probably the most unique. These trucks form the basis of the rolling stock handled by the famous Pechot locomotives and are designed to operate on a gage of 1 ft. 11⅝ in.

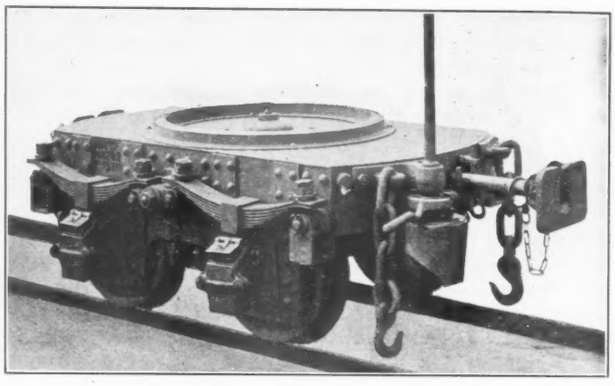
The trucks are of three types, four-wheel, six-wheel and eight-wheel, all equalized. Various combinations of these trucks, effected by means of car bodies, swivel platforms, bolsters and reach rods, provide a wide range of hauling capacity and adaptability to a variety of traffic, ranging from the movement of heavy artillery toward the front to the movement of wounded soldiers toward the rear.

The truck frames are built up of heavy plates and angles with pedestals along the sides for the journal boxes. The ends are curved and the top is covered with a checkered plate. Riveted to this plate is a steel circle about 27½ in. in diameter, the top of which is beveled outward. This circle performs the load carrying function of a center plate as well as that of side bearings.

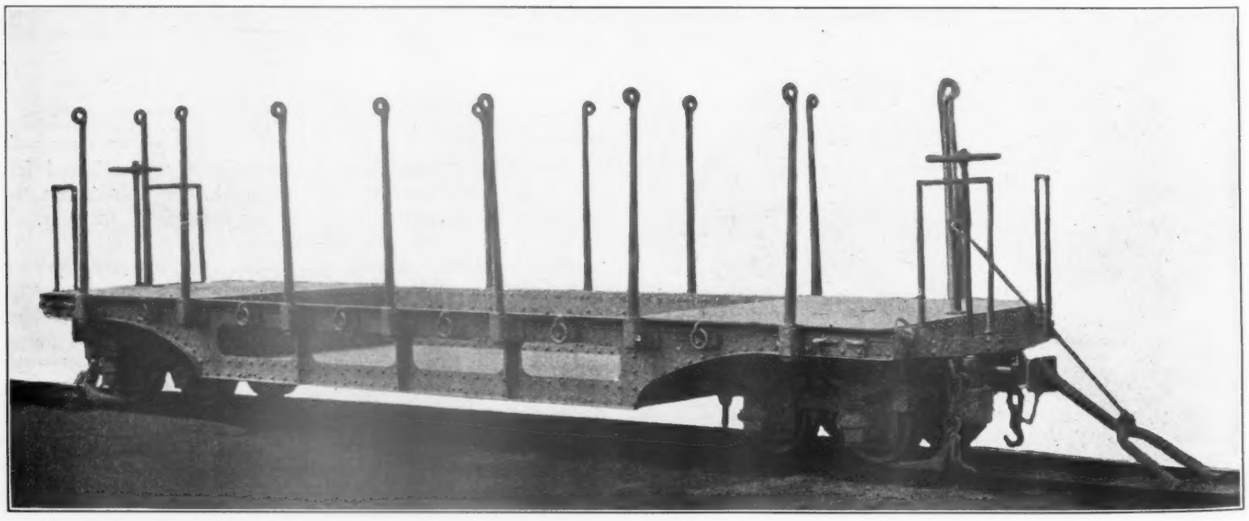
The journal boxes are provided with oiler lids on top of the front of the box and the cover is machined and bolted to the front of the box. Each box contains a forged wedge which fits over the bronze bearing. The top of the wedge has a half-bearing against a turned and hardened pin extending crosswise through the box, thus allowing the wedge and bearing a slight freedom of angular movement in a vertical plane through the center of the axle, when running on uneven rails.

The top of each box is formed with a pocket which provides a seat for the semi-elliptic side springs and equalizers. The frame of the truck is hung from the springs by means of eye-bolts with double nuts, which in turn are pinned to corner brackets of cast steel and to forged steel equalizers pivoted on the truck frame. The wheels are 15¾ in. in diameter of chilled cast iron and are bored out and pressed on the axles according to American practice. The brasses are machined all over and scraped down to a bearing.

Each truck contains a complete hand-brake mechanism which may be operated from the platform by means of a hand wheel mounted on a vertical brake mast, or from the ground by means of a forked handle pivoted to a sleeve turning loosely on the brake shaft, which meshes with a rachet wheel keyed to the shaft. In the lower end of the brake mast is a square socket which fits over the short squared end of the fixed vertical brake shaft. This mast may be removed whenever necessary. The short vertical shaft is forced into a cut bevel gear which meshes with a gear pressed on a brake screw extending longitudinally under the truck frame. The nut which travels on this screw is of forged steel with trunnions on the sides which operate in slots in the forked end of an arm on a horizontal shaft extending across the truck. Other arms on this shaft operate the brake shoes through link connections. The brakes are so regulated that a man of ordinary strength is able to cause all the truck wheels to skid under full load.



French Artillery Department Four-Wheel Truck



A Well-Car Body Mounted on Four-Wheel Trucks

At the brake end of each truck, the outer end when the trucks are in service under car bodies or are connected by reach rods, is placed a long stemmed buffer of forged steel.

This is connected through a volute spring and frame to the center pin, to which it is pivoted. A stop-bracket is provided on the end of the truck to hold the buffer stem central when no swivelling is required. The opposite end of the truck has a forged steel buffer similarly connected to the center pin but with no spring. When not in use this buffer stem is also held central by a stop bracket. When free to swivel, both buffers are centered by means of coil springs fastened to the side frames of the truck. A coupling pin is fitted into the end of each buffer with a keeper and chain, and one coupling link goes with each truck.

Forged steel anchors are riveted to the four corners of the truck frame and to these are secured heavy forged safety chains. The corner brackets which carry the side springs are designed with square sockets into which the ends of the side stakes from the car bodies or bolsters may be inserted for lifting the truck. All fitting parts are machined and all wearing parts are case hardened.

All three sizes of the trucks are of similar design, modified in detail as required for the different wheel arrangements and carrying capacity. The special feature in the construction of the six-wheel trucks is the arrangement of the equalizer system. Instead of using three springs, one for each journal box, but two are used. The heavier of the two delivers its load to the center of an equalizer the ends of which rest in the spring pockets of two adjoining journal boxes. This spring is equalized with the lighter spring over the third journal box.

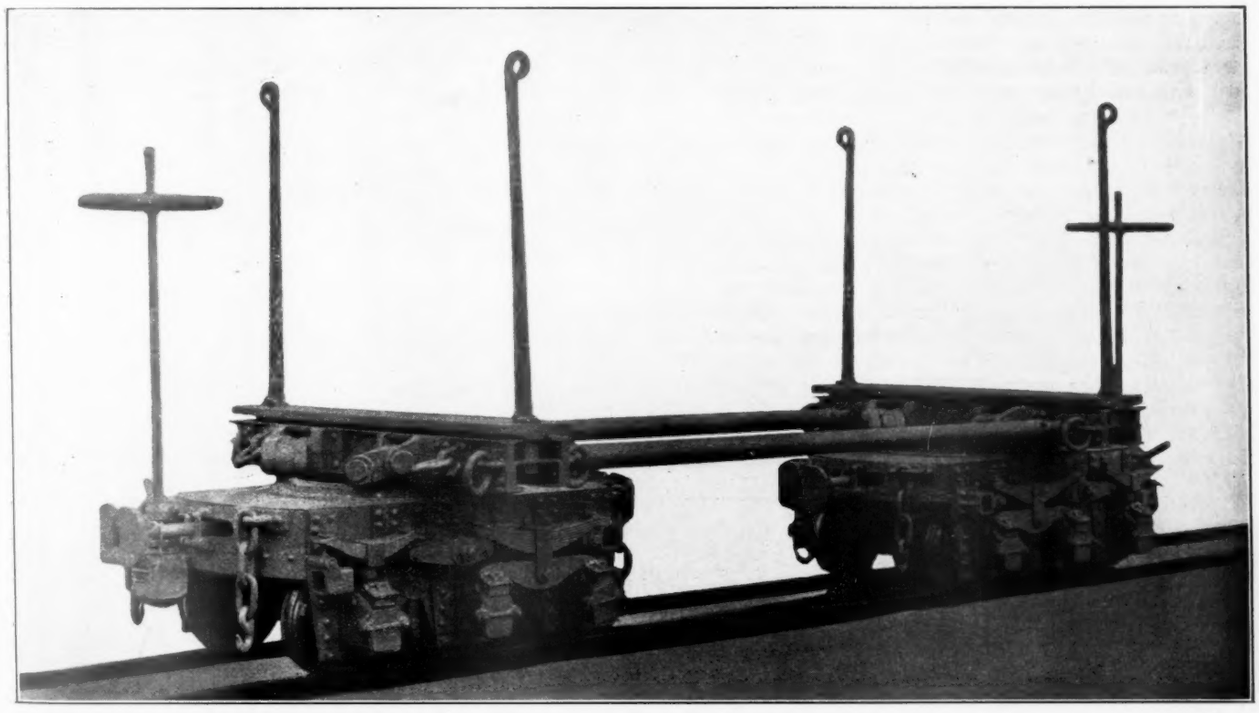
The following table gives the principal diminsiens of the three types of trucks:

	Four-wheel trucks	Six-wheel trucks	Eight-wheel trucks
Length over buffers..	6 ft. ¼ in..	6 ft. 6⅜ in.	7 ft. 7 in.
Length of frame.....	4 ft. 5½ in.	4 ft. 8½ in.	6 ft. 1⅝ in.
Width over all.....	3 ft. 9¼ in.	3 ft. 10½ in.	3 ft. 10½ in.
Height, rail to cover plate	1 ft. 8⅛ in.	1 ft. 8⅛ in.	1 ft. 8½ in.
Journals	2¼ in. by 4¼ in.	2⅜ in. by 5⅝ in.	2⅜ in. by 5⅝ in.
Capacity of trucks, metric tons	5	9	12

The eight-wheel truck is provided with two cross-frame, or bolster, members and center pins, to each of which is connected one of the buffers. Between these at the center of the truck is the main center pin and steel circle, which receives the swivel support or platform, as the case may be. Only the two end axles on the six- and eight-wheel trucks are mounted with flanged wheels.

The four-wheel trucks are used under open platform bodies in design similar to a well car. The principal load carrying members are the side sills, which are girders of the fish-belly type built up of 5/16-in. plates reinforced with angles at the top and bottom. Four large holes are punched out of each web plate to reduce the weight. The end sills are of rolled plate sections 5½ in. deep reinforced with angles at the top and bottom. A small curved platform is riveted to each end of the body to cover the curved ends of the truck. This platform is covered with checkered plate through which provision is made for the insertion of the brake mast. At the end are two hand rails.

Extending crosswise from side sill to side sill over the truck centers are bolsters built up of two pressed steel plates ½ in. thick, flanged at the top, bottom and ends. These are spaced at the center by a cast steel center bearing. At each end of the well there is a cross bearing built up of steel plates and angles. Extending from the center line of the bolsters toward the corners of the car body and the ends of the well cross bearers are diagonal braces of structural steel. At a distance from the center pin bearing corresponding to the radius of the steel bearing circle on the trucks four cast steel brackets fitted with forged steel rollers are riveted to the bolsters and diagonal braces.



Six-Wheel Trucks With Bolsters and Reach Bars In Place

Along the sides of the side sills are placed seven pockets in which are inserted forged steel stakes. Between the stakes on each side are placed six rings held in anchors riveted to the side sills. Between the end side stakes and each corner of the car is placed a double anchor and on the end sill at each corner of the car is secured an anchor and ring. Provision is thus made for securely roping or chaining loads in place, this being further facilitated by the eye at the top of each stake.

These cars are 20 ft. 10 in. long over all, the truck centers

being spaced 15 ft. 9 in. apart. The well is 10 ft. 3½ in. long by 5 ft. ½ in. wide and 1 ft. 2½ in. deep. The width of the car overall is 5 ft. 11½ in. and the ends of the car body are 2 ft. 3¼ in. above the rails. The load carrying capacity is eight metric tons, or 17,637 lb. The well car bodies are designed for use with the four-wheel trucks only. All three types of trucks are used with swivel supports or bolsters, two trucks with swivel supports being connected together by means of reach rods to form a load carrying unit somewhat similar to a farm wagon with the box removed.

The swivel supports or bolsters for the four-wheel trucks are built up of two side members of pressed steel ½ in. thick, flanged at the top and bottom and spaced at the center by a cast steel center pin bearing. The ends are separated by cast steel fillers through the top and bottom walls of which are square holes serving as stake pockets. At the proper radius from the center pin four cast steel roller brackets are riveted to the sides of the swivel support. These carry double rollers which run on the roller circle of the truck. On the front side of each bolster are placed two forged steel stake pockets and ring anchors combined. On the back side of the bolster near the ends, are attached forged steel ring anchors and rings. At the center is a steel hook which fits the eye on the end of the reach bar.

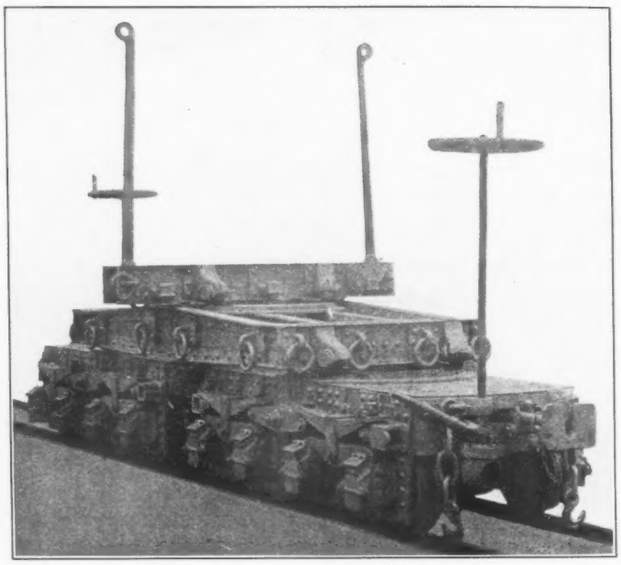
The reach bars for the four-wheel trucks are built up of lap-welded steel tubes, one end fitted to telescope within the other. Key slots through both parts are provided at intervals so that the bar may be adjusted to several lengths. At each end of the bar a forged steel eye is pressed and riveted in place. This fits the hook on the back side of the swivel support. Pivoted to the sides of the eye and swinging below it is a steel loop which hangs under the swivel support hook when the reach bar is in place and thus prevents the bar from accidentally being lifted off the hook.

With swivel supports and reach bars the four-wheel trucks may be used to handle rails, timber or other long materials for which the car body is not needed. On the well car body material in smaller units, such as shells, may be carried, and by slinging stretchers or hammocks from the eyes at the top of the side stakes it may be used for the transportation of the wounded.

The swivel supports for the six-wheel trucks are designed for heavier loading, and are built up of steel I-beams instead of flanged steel sections. A special steel table casting is fitted to the top of the swivels for use in transporting heavy guns, and there are forged stakes at the ends similar to those used with the four-wheel truck equipment.

The reach bars for use with the six-wheel trucks are similar in construction to those used with the four-wheel trucks except that they are of fixed length instead of being adjustable. Each swivel support is fitted with two reach bar hooks located outside of the roller brackets, instead of one hook on the center line of the truck as with the four-wheel trucks.

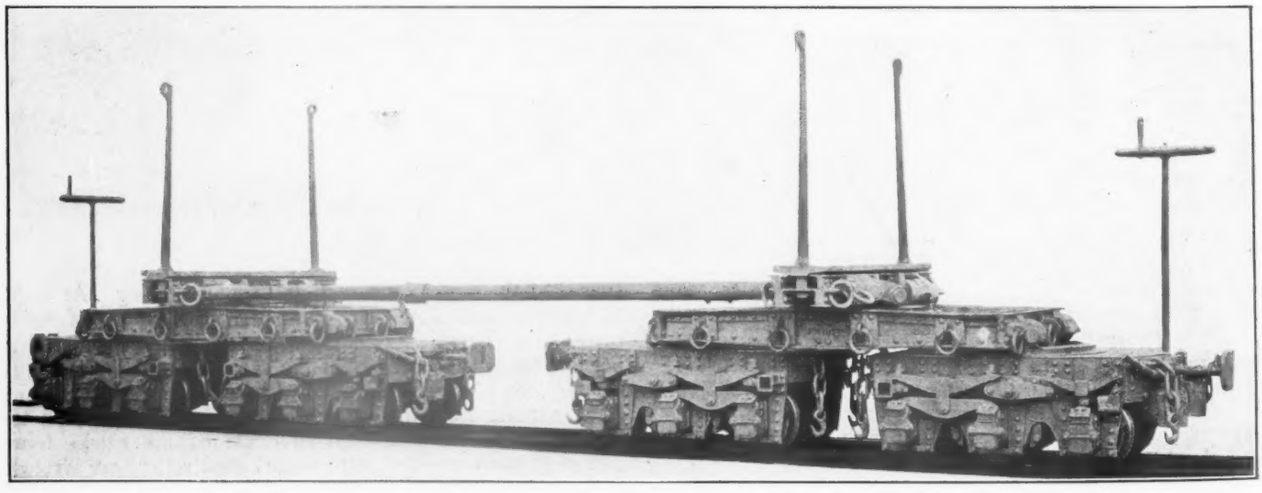
The swivel supports for the eight-wheel trucks are of the same type of construction as those used with the six-wheel trucks. The table casting, however, is used with the six-wheel trucks only and with the eight-wheel trucks three reach bars are used instead of two.



Platform and Swivel Support Mounted on Two Four-Wheel Trucks

The reach bars for the eight-wheel trucks are of a different type from those used with the smaller trucks. They are built up of channels arranged to provide for the telescoping of I-beams between them. A series of holes through the channels and I-beams and a shearing key provide for the adjustment.

The three sizes of trucks with swivel supports and reach bars thus provide carrying capacities of 10 metric tons, (22,046 lb.), 18 metric tons (39,683 lb.) and 24 metric tons (52,910 lb.) respectively. A further range of capaci-



A Unit of Four Six-Wheel Trucks Built Up With Platforms, Swivel Supports and Reach Bars

ties is provided by the use of so-called platforms with the six-wheel and eight-wheel trucks.

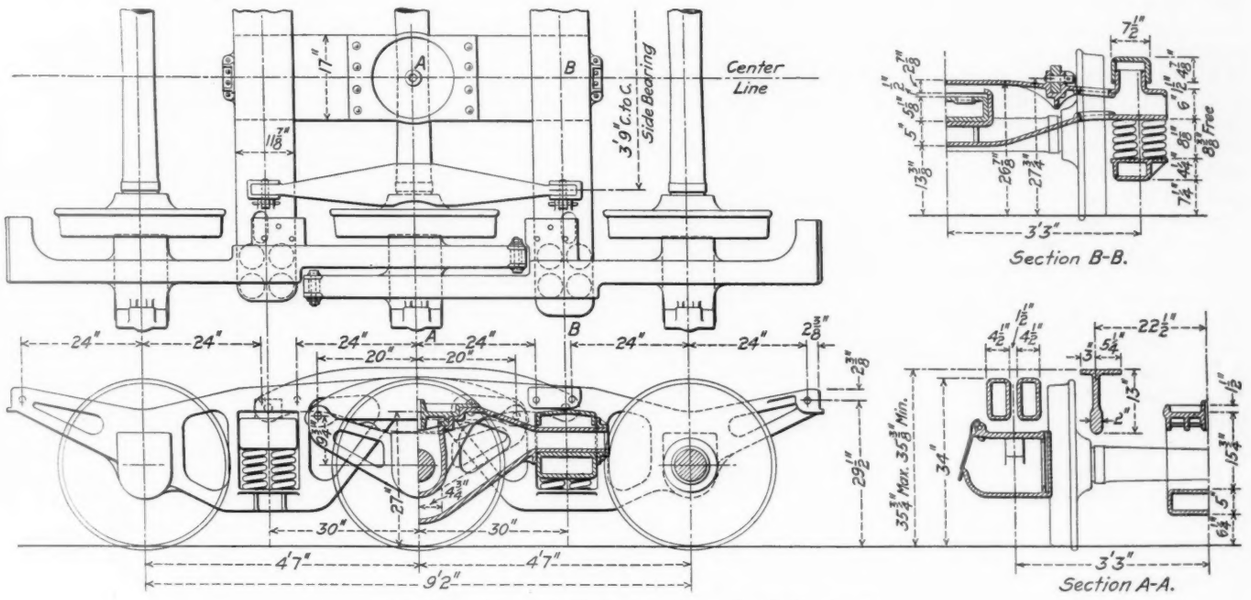
The platforms are built of channel sections and plates, and are used as bridges between the centers of a pair of trucks, placed as close together as the inner buffer clearance will permit. Under each end of these platforms is placed a center pin casting and roller brackets, the bevel rollers of which are designed to operate on the roller circle of the truck. At the center of the top of the platform is a center bearing casting and roller circle upon which may be placed a special swivel support of sufficiently heavy construction to support a load equal to the capacity of two trucks. On each side of these platforms are located heavy roping rings. The platform for the six-wheel trucks is 5 ft. 5 in. long from truck center to truck center and 6 ft. 2 in. long over all, while that for the eight-wheel trucks is 6 ft. 9⅞ in. long between truck centers and 8 ft. 3⅝ in. long over all.

By the use of two pairs of six-wheel trucks, each pair connected with a platform and the two pairs joined by means of swivel supports and reach bars, a load carrying unit is available with a capacity of 36 metric tons or 79,365 lb. With a similar arrangement an eight-wheel truck unit with a capacity of 48 metric tons, or 105,820 lb., is available.

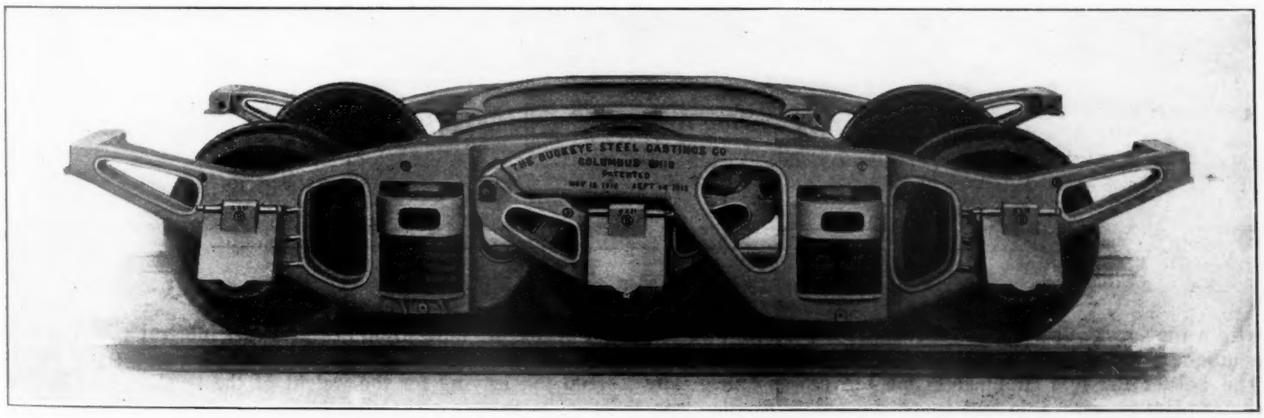
SIX-WHEEL TRUCK FOR VIRGINIAN 120-TON COAL CAR

A six-wheel truck design containing a number of unusual features has been developed by the Buckeye Steel Castings Company, Columbus, Ohio, for use under one of the four 120-ton experimental steel coal cars recently placed in service on the Virginian Railway. Sample trucks of a similar design, but for cars of 90 tons capacity, have been in operation since 1914 on the Norfolk & Western, and have given excellent service during their more than 50,000 miles of travel.

The car to which these trucks were applied was built by the Cambria Steel Company, and has a rated capacity of 218,000 lb., or 120 tons, with a 10 per cent overload, and 4,265 cu. ft. The light weight of the car is 83,300 lb., of which 48,650 lb. is in the car body and 34,650 in the trucks.



Plan, Elevation and Sections of the Buckeye Truck



Buckeye Articulated Six-Wheel Truck

The ratio of revenue load to total load, with a 10 per cent overload, is thus 74.2 per cent.

Although these trucks possess a flexibility equal to that of equalized six-wheel passenger trucks, the design is such that the entire truck body is composed of parts which may be manufactured in large quantities by steel foundries, thereby

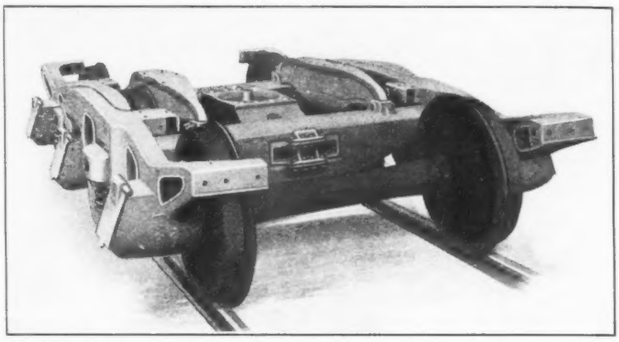
facilitating the making of repairs with limited shop facilities. The wheel base is 9 ft. 2 in., a short wheel base being particularly desirable for coal car service, in which uneven mine tracks with curves of small radius and steep inclines to unloading machines must be safely negotiated.

Each side frame consists of an outside and an inside frame, each with a 6-in. by 11-in. journal box cast integral. The middle journal boxes are cast with equalizer arms on either side, the ends of which are provided with pockets in which the ends of the side frames rest.

The equalizing of the cross bolster loads is thus entirely performed by the articulated side frames. By providing the frames with elongated holes through which the equalizer bolts pass, a limited amount of forward and backward movement of the frames is allowed, thereby affording flexibility to the sides of the truck and enabling it to take comparatively short curves with no appreciable binding of the wheels. The location of the bolsters in the side frames is such that the distance between the point of loading and the center of the end journal is one-half of that between the point of loading and the bearing point in the equalizer pocket. Any unbalanced load on one of the frames which causes an upward or downward movement of the equalizer arm, is immediately counteracted by a shortening or lengthening of the moment arm between the point of loading and the bearing point in the equalizer pocket, the contour of which is designed to compensate in this manner for variations and inequalities in loading. The equalizer bolts serve only to hold the side frames and equalizers in place, the load being transmitted directly through the bearing between the castings.

The bolster is made up of three parts, i. e., one longitudinal center bolster and two cross bolsters. In order to keep within the low limit of 27 in. for the center bearing height, a unique type of longitudinal center bolster was developed. The bolster itself is dropped below the center axle. The center plate is removable and spans the axle. Ample clearance is provided between the center plate and the bolster member below the axle to allow the axle the necessary freedom of vertical movement to provide for passing up and down steep inclines to coal docks, or in case of derailment to insure against excessive strains which might otherwise be imposed upon the castings.

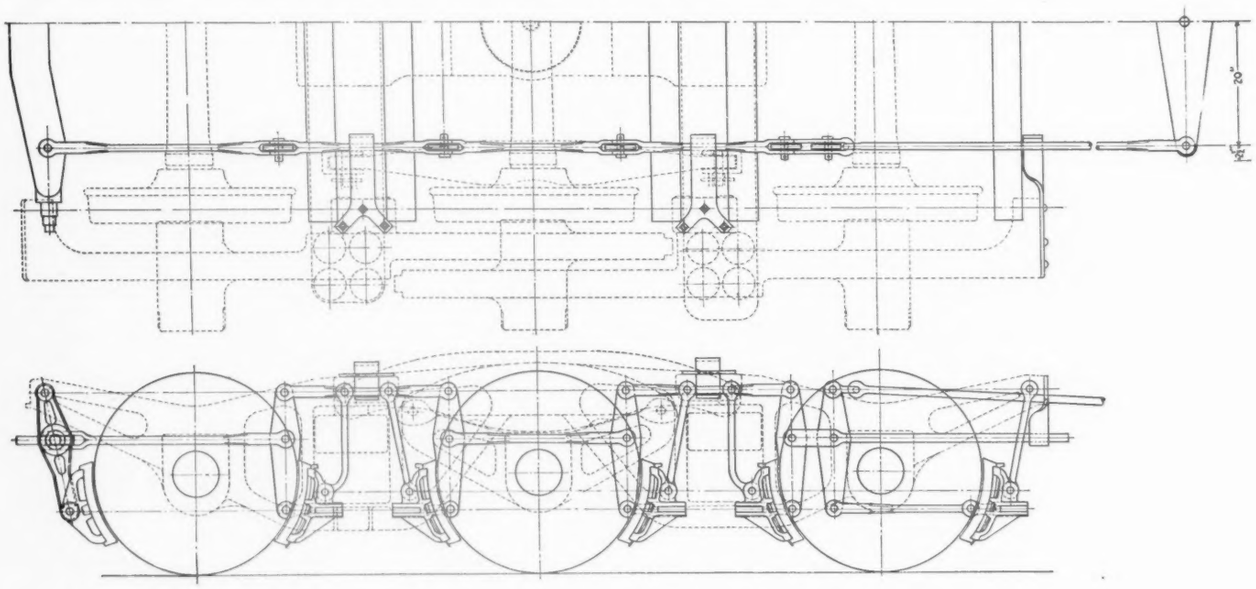
The cross bolsters are cast with openings through which pass the ends of the center bolster. Sufficient clearance is provided to allow a limited movement of the center bolster, thereby adding to the flexibility of the truck and greatly facilitating the ease with which the bolsters adjust themselves to inequalities of loading. The side bearing bridges are arranged on the inside of the frames and are supported directly by the cross bolsters. Rectangular shaped boxes on top of each end of the cross bolsters fit into recesses in the top members of the side frames. These boxes serve as column guides.



End View of the Truck Showing the Connection of Longitudinal and Cross Bolster

The side frames and equalizers are of channel section, including the brake brackets at the end of the frames. The two inside frame castings on each truck are interchangeable, as are also the outside frames.

The trucks are equipped with a clasp brake of extra heavy pattern designed by the American Brake Company. All beams are hung from brackets cast integral with the side frames. The weight of the clasp brake rigging per car is 4,100 lb., leaving for the weight of the trucks alone 30,550 lb. The steel castings account for 14,580 lb. of this weight.



Clasp Brake Rigging Applied to Buckeye Trucks Under Virginian 120-Ton Coal Car

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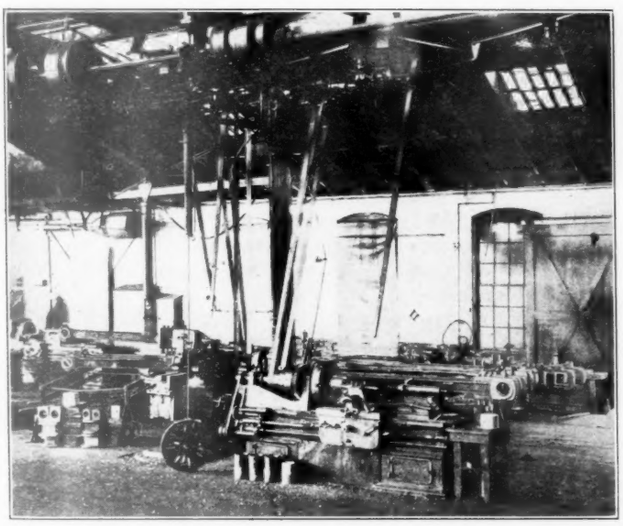
Increasing Freight Car Efficiency.—The Railroads' War Board has, in the interest of freight car efficiency, directed the Master Car Builders' Association to modify its rules for the period of the war, so as to make possible the use of any material that is on hand which will enable cars being held for repairs to be put into service without waiting for materials from the owning road.

SHOP PRACTICE

LOCOMOTIVE ROD WORK*

BY GEORGE C. CHRISTY

The illustration shows the rod department in the McComb, Miss., shops of the Illinois Central. At this shop after the rods are removed from the locomotive they are moved to the lye vat just outside of the shop and near the rod department. The bushings, etc., are removed and the rods are placed in the vat and cleansed thoroughly. They are then inspected by the foreman of this department. At this time the foreman gives proper credit to that particular locomotive for its scrap material, and issues a requisition for the necessary new material. The rods then go to the blacksmith



Rod Corner at the McComb, Miss., Shops of the Illinois Central

shop or the rod bench, according to the work to be done on them. In making repairs to rods they should not leave the rod gang except only when they go to the blacksmith shop. We have iron racks or trestles to put the rods on, as it has been found that they may be handled more easily than on wood trestles, also there is less liability of an accident. We have air hoist cranes so arranged that one man can handle the heaviest rod to any place that he desires. The shaper should be in the rod department to machine the brasses, straps, wedges, etc., and a lathe to machine the brasses, knuckle pins, wrist pins, bushings, etc. A small air hoist is arranged to serve both the shaper and lathe, in order that the operator can handle any job on these machines without assistance.

There can be considerable money saved by placing an emory wheel stand convenient to the rod bench; this will reduce the chipping and filing to a minimum. We use screw vises and air clamps on our rod bench. The air clamps on the rod bench are arranged so that the clamp moves perpendicularly through the bench, making it unnecessary to lift the heavy brasses, straps, etc., to the vise. We also have a small device arranged with an air motor that is used as a small milling machine in making fillets, etc.; this also reduces chipping and filing considerably.

When solid rods have been machined we store them outside the shop, convenient to a combined hydraulic and drill press, where the bushings are pressed in and the grease and set screw holes may be drilled with a minimum of handling. The press is served with an air hoist crane, as is the rod job inside, which will lift the heaviest rod. This press is also used in removing bushings before the rods are put in the lye vat to be cleansed.

Locomotive rod work should be specialized as far as possible, as it will reduce the cost of each operation and the men become experts in their particular jobs. When it is necessary to apply two or more new rod brasses or fit up new straps in the round-house this work is sent to the rod gang, which can do it much cheaper than the round-house organization.

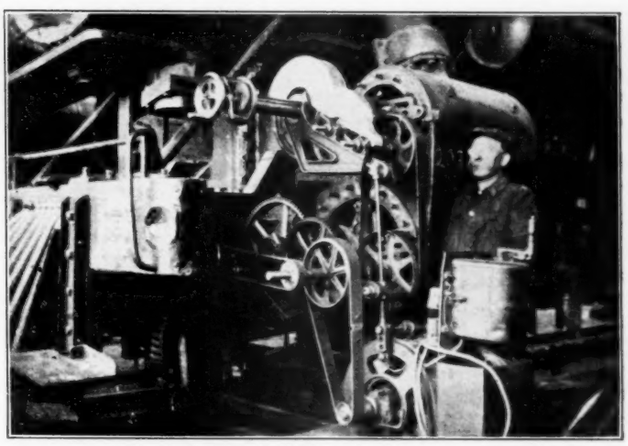
* Entered in the Rod Job Competition.

BORING CYLINDER AND VALVE CHAMBERS

BY A. C. HINCKLEY

Superintendent Motive Power and Machinery, Oregon Short Line

The arrangement shown in the illustration for boring both the cylinder and valve chambers at the same time has been used at the Pocatello, Idaho, shop of the Oregon Short Line for some time and has given very satisfactory results, reducing the time formerly required to do this work by almost



Arrangement for Boring Cylinder and Valve Chambers at the Same Time

50 per cent. The boring bars shown are the ones previously used separately for doing their respective work. They are arranged with pulleys as shown, which are driven by belts, a portable motor being used to drive the mechanism. The motor is belted to a pulley on a shaft attached to the cylinder boring bar mechanism. On the extreme right of this shaft is another pulley, which is belted to a pulley on the valve chamber boring mechanism, and in this way both chambers

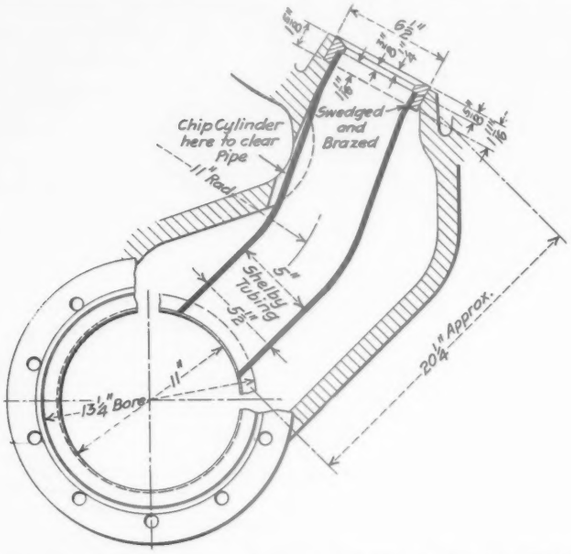
are bored at the same time. The average time required to set up the machine, bore out the cylinders and valves, and take down the apparatus is five hours per locomotive.

CYLINDERS WITH CRACKED STEAM PASSAGES RECLAIMED

BY R. A. H.

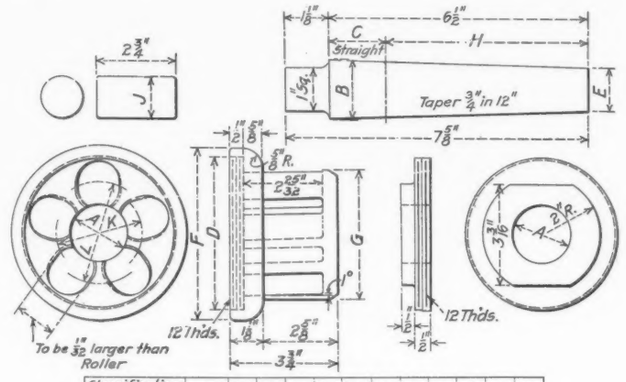
A certain class of locomotives developed an epidemic of cracks through the steam passages of the cylinders which made them unfit for service, although the structural strength of the cylinders was not seriously affected. By the following method the cylinders were repaired and continued in service.

A bushing was applied in the saddle at the steam pipe seat, into which was swedged and brazed a length of Shelby tubing 5 in. in diameter which extended down into the valve bushing, as shown in Fig. 1. The valve bushing is in one piece and a hole was cut in the center to receive the end of the Shelby tubing, which is rolled into the bushing with the roller expander. It will be noted in Fig. 1 that because of the crookedness of the passage the cylinder wall had to be cut out to allow the application of the tubing.



Cracked Cylinder Steam Passage Repaired With Steel Tubing

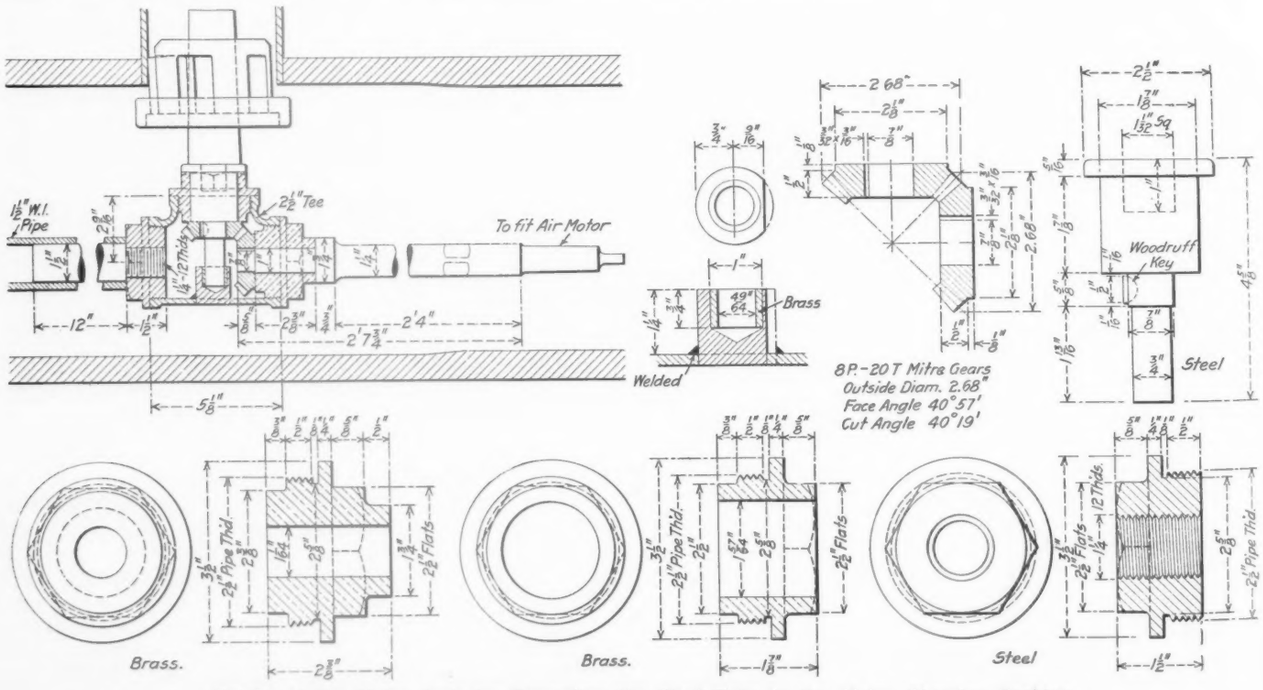
The tubing is rolled into the valve bushing with the tools shown in Figs. 2 and 3. The body of the tool in Fig. 3 is a 2½-in. tee with a lug to serve as a pinion for the mitre gear welded in the bottom. The caps of the tee also serve as bushings in which the two shafts have bearings. The tool is driven by an air motor at the front of the cylinder which, with the arm of 1¼-in. pipe extending to the back of the cylinder, allows the expander to be held in place during the operation.



Classification Number	Size	A	B	C	D	E	F	G	H	J	K	L
E-41	4½"	2 1/16"			4¾"		5½"	4"		1¼"	2¾"	3¼"
E-42	5½"	2 1/16"			5½"		6¼"	4¾"		1⅝"	3½"	3⅞"
Pin No. 1						1½"						
Pin No. 2			1⅞"	2½"		1⅝"			4"			

Details of the Roller Expander

The repairs made to cracked steam passages by this method have proved durable and effective; the only maintenance required is the re-rolling of the tubing into the valve bushings at shoppings.



Details of the Motor Jack for Expanding the Steel Tube in the Valve Chamber Bushing

THE ninth annual meeting of the Santa Fe apprentice instructors was held April 23, 1917, in the apprentice school building at San Bernardino, Cal. F. W. Thomas, supervisor of apprentices, introduced H. S. Wall, superintendent of shops at San Bernardino, who delivered an address of welcome; he said in part:

When the apprentice system was started at Topeka in 1907 there were only 345 apprentices. Today there are 1,028 grouped according to the following table:

	1907	1917
Machinists	231	595
Boiler makers	35	161
Blacksmiths	15	16
Coach carpenters	24	28
Freight car carpenters	—	135
Tinners and pipefitters	20	36
Painters	15	16
Upholsterers	1	4
Electricians	—	4
Specials	4	33
Total	345	1,028

We have had to date 1,014 graduates, 151 of which are holding official positions at different points on the system. Several special graduates are being given further training with outside corporations, such as the Baldwin Locomotive Works, Westinghouse Air Brake Company, and the Pullman Company.

Those directing the system not only take great pride in graduating the best possible mechanics, but also take much pride in keeping the system clean, by selecting applicants that are reasonably well educated and from good families.

OUR DUTY TO OTHERS

S. L. Bean, mechanical superintendent at Los Angeles, said in part:

Arrogance on the part of higher officials will soon be successfully imitated by the under officials and so on down to the lesser employees, and the service will suffer until a crash comes and a reorganization of the official family is made necessary.

Consideration for others is about the cheapest investment that a man can make, also the surest and safest.

The great genius can afford to be a grouch—after the world has discovered that he is a great genius—but the chances are if he is a grouch during the time he is struggling for recognition, his genius will not be discovered.

Genius, like everything else, has to have a chance. If Edison had been surly and ill-natured in the days when he was a struggling operator, it is quite possible that he never would have had an opportunity to be anything else; for it is stated that out of every million people, less than one is a genius. The others have to make their way by using all their abilities.

Courtesy is really nothing but common consideration for the rights and feelings of others. It is recognition of the well known fact that no man can be independent of others and succeed without the help of his fellow man. It is easy to be discouraged in the big fight you are making to get where you want to go, and a discouraged man's first impulse is to be surly—to try to take it out on somebody else, usually some innocent person who has had nothing to do with the cause of discouragement.

The man who expects to slide to success on skids, as a ship slides from its ways into the water, will get a rude awakening before long. It is a long hard road, beset with difficulties, and often seemingly impassable; but it can be traveled far more easily by the man who keeps his temper than by the man who does not.

The even-tempered man has a chance to use all his mental capacity on his job. He is never ruffled by quarrels of other peoples' starting, for he never allows them to disturb him, and being courteous himself, he usually excites courtesy in other people, which makes his path through life very pleasant indeed.

Remember always that courtesy costs nothing. If all men employed it there would be no fighting, no wars and very little unhappiness.

If you find that you are having a harder time than you ought to in getting ahead, try the experiment of being unfailingly courteous. It has proven a great benefit in some large corporations. I know of a case where thousands of men had to be trained in it. It will certainly benefit you.

I trust you will make use of some of these suggestions in your daily contact with our shop employees, outside of your immediate charge, in your work as instructors of apprentices. Try and assist all with whom you come in contact, especially when new men are employed, mechanics, helpers, etc. Make them feel at home, and have them feel they can look to you as a friend.

HUMAN TOUCH IN TRAINING APPRENTICES

E. H. Harlow, master mechanic at Richmond, Cal., pointed out that the time when an apprentice makes application or passes through the first six months of his apprenticeship, is the most critical time of his life. He should be

questioned as to his home life, his education, his morality, etc., in order that the instructor may become fairly acquainted with the boy's environment. After the boy is employed, he must be so handled as to make him understand that he is being treated squarely. If the boy is not treated right at this critical time, it may be the means of discouraging him, and spoiling his whole life. Mr. Harlow also emphasized the importance of taking care of the boy outside of shop hours, as well as during working hours, and urged that everything should be considered before any young man was taken out of service.

APPRENTICES AND SPECIAL WORK

Certain classes of work in railroad shops are usually assigned to specialists. In the smaller shops many special jobs are performed by one man. It is essential that the apprentice, some time during his apprenticeship, receive experience on these jobs. The instructors agreed that the only way he could do this was to be put with the man doing the work. The objections to this arrangement came from the fact that this would lower the bonus earnings of the mechanic working on the job, and the latter would object, feeling that money was being taken out of his pocket; in addition to his dissatisfaction, he would not be very likely to give the apprentice the instruction that would be necessary for him to become familiar with the work. Two or three remedies were suggested for this; one, that the schedule be increased so as to permit the apprentice boy to work with the journeyman and still let the journeyman make about the same bonus that he made before. Another suggestion was to let the apprentices' work be counted as day work. It was pointed out, however, that this would be contrary to the instructions, in that it would not be permissible to show the apprentice as on day work and permit the journeyman to be credited with all of the work done on the job. Moreover, this would interfere with the correct distribution of the time on the job.

The discussion of this subject also brought up the question as to whether apprentices should work in apprentice gangs or with journeymen mechanics. A vote was taken on this, resulting in favor of working the apprentices with skilled mechanics. It was understood, however, that the boys should be put with the best mechanics, and should not be used as helpers, but should be given an opportunity to learn the work, and that the shop instructors should be held responsible for seeing that the apprentice is given an opportunity to learn all the work of his trade.

MONTHLY REPORTS

These reports are the individual records kept of the apprentices. The supervisor of apprentices stated at the outset that he desired these reports to be complete in all details—as nearly a perfect record of the apprentice during his four year apprenticeship, as it is possible to make it—that he wanted them to be such a faithful likeness that anybody unacquainted with the boy would be able to form an intelligent opinion of the apprentice. The various headings on the report seemed to be satisfactory to all the instructors, but the method of indicating the apprentices service was not altogether satisfactory. Some of the instructors thought that the letter system was preferable to numerals. It was decided, however, to go back to the use of numerals beginning with the next calendar year.

These reports are supposed to show the time that each apprentice is on different machines or in different gangs on the floor, regardless of the number of times he may be changed from one class of work to another. This requires the shop instructor to keep a detailed record of each apprentice, and in shops where an apprentice may be changed a dozen times a day, it involves a great deal of clerical work. It is necessary, however, that such a record be kept in order that the time of each apprentice be properly proportioned to the various gangs and machines. The supervisor of apprentices stated that he preferred that the records show the progress the boy is making, rather than the quantity or quality of the work. In other words, the apprentice should be measured by the improvement he is making in his work.

LOCOMOTIVE FOLIO*

Discussions revealed various methods of holding meetings and studying the folio at shop points. Some were good, some useless. At some places the folio is guarded and kept so sacredly that many have little or no opportunity of reading it. Some men are called into the folio meetings who have never had the chance to see or study it. The booklet of questions recently published for use in the apprentice schools, has proven its worth by the manner in which the apprentices use it, and further its adoption and use at the folio meetings at many division points has created a greater interest in the study of the folio. It was suggested that additional questions be added every three months to cover new pages or changes. For the immediate benefit and effective results it was suggested that when a new page is issued, or revision made of old pages, that the men actually engaged in the work referred to by the new or revised page be given an opportunity to read the page, and have the subject or changes explained to them. This could be effectively handled by the local instructors.

Instructing an Apprentice in the Fitting Up of a Crosshead

The supervisor of apprentices advised the instructors that wherever they observed work not being done in accordance with the folio, whether by apprentices or others, that the apprentice be corrected at once, and the attention of the officer in charge be called to the deviation from standards if the work is being done by a journeyman. This should be done on all occasions, regardless of circumstances, even when only temporary repairs are made, in order that the work may eventually be made to conform with the folio requirements.

SCHOOL ROOM WORK

A complete revision of the drawing lessons was recommended for the following reasons: Many of the models had ceased to be standard articles or devices, and the lessons should conform to standards of the road and should also comply with the folio. There are at present 250 plates; it has been found necessary to reduce the number to 200, for

*This book contains the locomotive standards and standard practices.

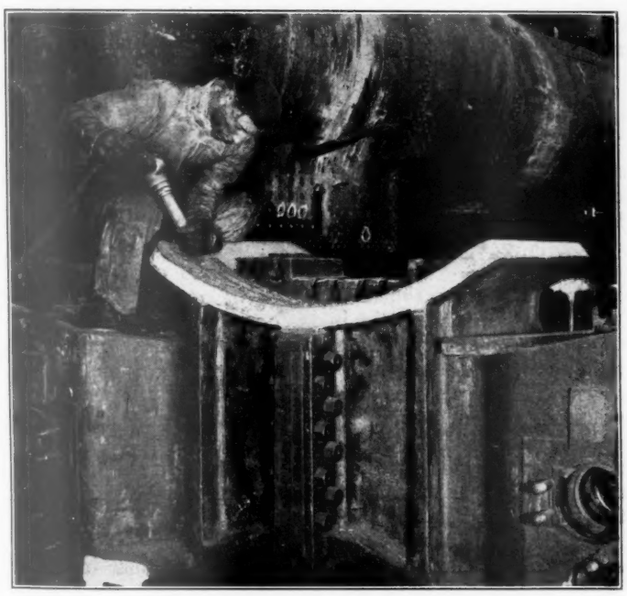
the reason that additional school room work takes more of the apprentices' time than in the early years of the organization. The locomotive folio requires more time, and the introduction of more reading matter and examination questions also take more time. Many of the drawing plates have been consolidated, making the lessons more comprehensive and instructive. The first 50 plates have been so arranged as to be made applicable alike to all apprentices, regardless of the trade. Above this number, the lessons in drawing will be arranged to suit the various trades.

The present plates will be gradually supplanted to comply with these suggestions. At least a year will be required to make the complete change. An entire new series will be prepared for the freight car carpenters. The boilermakers and tinners need more of a descriptive geometry type of drawing, this being particularly useful in laying out and development work.

PROBLEMS AND QUESTIONS

It was brought out in the discussions that the problem lessons should also be revised. The problems on leverage should be simplified and extended. Other problems should be added to meet new conditions. The series of questions for the machinist trade is to be revised, as they have been in use for seven years. The present series for boilermakers and freight car carpenters are satisfactory. New series are to be developed to cover the tinners, coppersmiths and pipefitters.

The following was adopted as a standard requirement, this being a little more than the average amount of such



Apprentice Chipping Cylinder Saddle

work now being accomplished in the various schools over the system:

1st six months	35 drawings	100 problems
2nd six months	30 drawings	100 problems
3rd six months	30 drawings	100 problems
4th six months	25 drawings	100 problems
5th six months	25 drawings	119 problems
6th six months	20 drawings	.....
7th six months	20 drawings	.....
8th six months	15 drawings	.....

After the first 519 problems are completed (about 2½ years) supplementary work should be given in shop mathematics, according to the needs and ability of each apprentice. This gives a total of 200 drawings to be completed before graduation.

It was suggested that mathematics should be given in each school period for 30 minutes, and that only in special or extraordinary cases, should the time be extended beyond 30 minutes. It was the opinion that this scheme would overcome the present dislike for mathematics which some of the boys manifest, especially when they have been required to put in so much time with mathematics and little or no time on other subjects. The instructor should give the boy more individual attention while he is at work on his mathematics than is necessary while he is studying drawing.

STANDARDS FOR APPLICANTS

It was agreed that it was important that apprentices should have a common school education, if possible, but in passing on a boy's fitness the instructor should study the individual applicant and take into consideration the opportunities that he has had. Many good boys have been deprived of the opportunity of obtaining an education and yet are mentally alert and capable of doing well, if given a chance. With such boys the instructor should not insist on his having completed any particular grade in school, but should rather pass on the boy's mentality. The instructor has a two-fold responsibility; he is responsible not only to the company, but also to the boys. The boys are at a period in life when it is most difficult for parents or educators to deal with them. They seem to be constantly changing and are easily influenced. With them, success in life depends largely on whether or not they get started in the right channel. The instructor can do much to assist each boy in picking out his vocation, and in doing so he will not only be conferring a life time blessing upon the applicant, but will likewise assist the railway. The company's best interests will be taken care of when each employee is given the work best suited to his ability. The instructor should see that the average schooling of his apprentices is as high as possible, but at the same time he should remember when examining each boy that he should get at the heart of the boy, as well as the head.

BY-PRODUCTS OF THE APPRENTICESHIP SYSTEM

During the past decade, through its apprentice department, the Santa Fe has greatly improved both the quality and quantity of this product. Over 700 skilled apprentice graduates are at present working in its shops, at points where they are most needed. At its largest shop, in spite of the present demand all over the country for mechanics and the high wages offered them, it has not been necessary to employ a mechanic from the outside for over 2½ years. This condition is due to the intense loyalty of these apprentice-graduates, evidenced by the large per cent remaining in service. The value of this product alone would more than justify the expense and effort of the apprentice department.

Just as the manufacturing industries, however, have long since learned that in the production of the primary product certain opportunities arise whereby with little additional effort or expense, secondary products known as by-products may be produced, so in the developing of these skilled mechanics opportunities arise for producing other valuable results, a few of which I shall mention here.

The Promoted Graduate.—Let us first consider the promoted graduates, very rapidly increasing in number. As the system of apprentice instruction has been broadened in scope and rendered more efficient; as the increased opportunities given the apprentices have attracted a better class of boys with which to start; as the apprentice boards have studied more closely the fitness of each boy and weeded out the undesirable material at an early date, thus making room for more and better boys; as the apprentice instructors have entered more closely into the real life of each of their boys and learned more of their ability and capacity, more of their talents, active and dormant; as they have passed on to their local officers and to the central apprentice organization the

knowledge they have thus gained—more and more of these graduates have been given positions of trust and responsibility. These young men have made good and justified the confidence placed in them, and proved to the management the value of the apprentice instruction and the reliability of the recommendations of the apprentice organization.

Today there are over 150 of these graduates occupying official positions, some of them of no little responsibility. All of these young men completed their apprenticeships within the past decade. Only those who were graduated during the past five years received the benefit of full four years of the modern apprentice instruction. None of them received the full and complete instruction and training and experience given the apprentices today, for the department is constantly improving its courses. What may not be expected of these boys in another ten years, to what heights may not some of them climb, what great things may they not do for the Santa Fe and the community in general?

The production of this by-product, instead of interfering with the production of the primary product, the skilled mechanic, really increases both the quality and the quantity of the primary product, for more and better boys are attracted to the apprenticeship system, and more of them remain with the company after graduation, knowing that no one else could offer them better treatment. They realize that if they are to receive promotion they must prove their ability by taking full advantage of the opportunities which are offered them.

Preparedness and Watchful Interest.—The next by-product is closely related to the one just mentioned, in that it gives evidence not only of the ability of these young men, but also of the full interest taken in them by the department. I refer to the last three Ryerson scholarships awarded by the Master Mechanics' Association having been won by Santa Fe apprentices. These scholarships, which by the way are sufficient to pay necessary expenses for a four-year college course in mechanical engineering, were open to all young men in the United States, particularly those having a high school education and at least two years of shop training. The fact that Santa Fe apprentices have won this coveted prize three times in succession, certainly is no small honor.

But proud as the company should be of these winners, still prouder should we be of the conditions which brought about those victories. Without doubt there were many capable young men on other roads. It is possible some of these may have been as talented and possibly as fully prepared as were the winners, but the Santa Fe apprentice boys were not only capable, talented, and prepared, but through the apprentice organization and its constant watchfulness for good things for its young men and for the company, they learned that these scholarships were to be awarded, and not only received full information regarding the contest, but the instructors took pains to pick out the most promising and get them lined up for the examination. This same spirit of preparedness and ever-watchfulness is in evidence in many other phases of this work, and is giving the Santa Fe returns which, though difficult to estimate, are of such value as to make this by-product worthy of consideration.

Technical Work of School Instructors.—Another by-product worthy of mention is the technical work of the school instructor. As one of the few technically educated men in the shop, he is called upon for advice or suggestions on matters of great importance. His special duties vary from making a design for a new shop whistle to determining how many cars a new type of locomotive will pull over Tehachapi. The apprentice school rooms are fast becoming emporiums of mechanical information, to which everyone in search of mechanical or technical information, of no matter what nature, is urged to come and partake of the waters that flow freely. It must be a source of great pleasure to the master mechanics to have on their staffs school instructors who can be trusted with matters of a confidential nature and depended upon to work out a solution of all technical questions that may arise. In addition to his special duties the school instructor generally has charge of all the shop drafting, and looks after all the shop blueprints. His entire salary is charged to the apprentice department, but were it not for him, someone else would have to be employed to look after much of this work. It does not require very much of a calculation to realize something of the real value of this by-product.

Work of Shop Instructors.—There is also a by-product from the work of the shop instructor. Since he works in harmony with the foreman, he is thoroughly familiar with his duties. If for any reason the foreman is absent, the shop instructor is ready to take his place. Furthermore, since the shop instructor is held responsible for the thorough instruction of the apprentices, and for all work spoiled by the apprentices, the foreman has more time to devote to other duties. Since the shop instructor knows what boy is best fitted for performing any job that arises, and also knows what boy needs the experience offered by the job in question, and can best give the instruction when the boy first starts on the job, the foreman usually assigns the work to the apprentices through the shop instructor, thus being relieved of any further trouble in the matter.

Every one likes to do what he can do well. No school is disorderly wherein the pupils are interested in their work. Just so in the shop. Through the work of the shop instructor the apprentices are kept interested in their work, and as a result little effort is needed to keep them busy, and as they are constantly busy the other mechanics get the fever, for industry, like idleness, is contagious, and thus the foreman is relieved of the necessity of devoting so much time to driving his men. If it were not for these shop instructors it is needless to say there would be need of greater supervision in most of the shops. As has been stated, the salary paid the shop instructor should be considered not an expense, but the most profitable investment that can be made. He is the most necessary part of the whole apprentice organization.

Shop Output of Apprentices.—The shop output of apprentices is perhaps the most visible by-product of the department. The systematic instruction given an apprentice boy from the day he enters his apprenticeship until his graduation produces a much greater output than one would expect. The apprentices are taught the latest and most up-to-date methods of performing each class of work, and from the start are not only taught habits of industry, but also made to realize that time is fully as important as material, and thus made to do their work with the minimum waste of either material or labor. The results have shown conclusively that the extra work turned out by these boys while apprentices, more than justifies the entire cost of their instruction.

Present Industrial Situation.—Thanks to its apprenticeship system the Santa Fe is unusually well prepared to meet the drain which the present war situation is making on the shop forces of all the railroads and manufacturing concerns in the country. Should it be necessary to employ raw recruits to fill the places of those entering government service, the system of instruction already in vogue in training its apprentices can be used to give necessary instruction to other men who may be employed.

Effect on Other Employees.—Another by-product of the department is the improvement in the general moral tone of the shop. Many of the requirements made of the apprentices have had a very wholesome effect on the other shop men. They are more regular and prompt in reporting for work, more particular about the quality of the work they turn out, more desirous of learning the latest and best

methods of performing their work, more willing to pass on to others the benefits of their experience, more confident in the management, and more loyal to the Santa Fe. From the fair treatment at all times demanded for the apprentices, there has gradually come about a better treatment of all the men in the shop.

EFFECT ON LIVES OF APPRENTICES

In conclusion I wish to mention one other by-product, one more important than any of the others, yet closely intertwined with all the others, and very necessary to the full enjoyment and development of each of the other products. I refer to the influence exerted by these fatherly and companionable instructors upon the lives of the young men in their charge. The instruction and counsel given them, the example set before them by their own conduct and daily life, has a large influence in molding the habits and ideals, the ambitions and aspirations of these young men just entering into manhood.

What a world of opportunity for achievement in the army of over a thousand boys now in these apprentice schools. Who knows which of them will develop into a future Steven-

Apprentice Laying Off Shoes and Wedges

son, a Marconi, a Thomas Edison, or a Matthias Baldwin. What a glorious thing to have a part in the development of such a life; what an awful thing to feel that the possibilities of any life have been blighted by any act or shortcoming of ours. You have similar boys working with you. Are you giving them the best that is in you? Do you not owe this to them and to the company by whom you are employed? Surely, there is no greater opportunity for usefulness than the development and improvement of the human element. Does not modern apprenticeship pay? Is it not well worth the effort?

Responsibility of Instructors.—Supervisor of Apprentices Thomas reminded the instructors that they were jointly responsible with the apprentice for any defective work; that they should advise the apprentices to come to them in case of doubt, and not to proceed with any class of work unless they were satisfied that they understood it.

Condition of Machines.—In order that the best possible work, both as to quality and quantity, should be turned out by the apprentices, it is necessary that the machines or tools operated by them should be kept in good condition. The shop instructors should make a monthly report to the general foreman, giving in detail the condition of each machine operated by apprentices.

Moral Welfare.—It is incumbent upon the instructor to look after the moral welfare of the apprentices outside of working hours as well as in the shop. He should be in a position to know what the boys are doing outside of working hours, and should be in such harmony with the apprentice as to be able to advise him in such a manner that the advice will be heeded.

Instruction of Apprentices.—While it is necessary in some shops to work the apprentices with the journeymen, the responsibility of the instructor does not cease when the apprentice is turned over to the journeyman; it is necessary for him to see that the apprentice does the work right, regardless of whether he is working with a journeyman or working by himself. At a number of the shops where there are only two or three apprentices in different trades, the instructor should not neglect these boys. He should see that they are given as good an opportunity as consistent with local conditions. He should in a measure familiarize himself with their work, and see that it is being done properly.

Location After Graduation.—The instructor is responsible for the apprentice after he completes his apprenticeship. He should know to what class of work he is better adapted, and should endeavor to so locate him that the company as well as the apprentice will profit. The instructor should not wait until the last moment to locate the apprentice, but should confer with the shop officials a month or more ahead of time.

Selection for Special Work.—We have been called upon from time to time for graduates for special duties or special course apprentices, and it has been necessary to rely a good deal on the judgment of the instructors in selecting these men. Not enough attention has been given to the real qualifications of the graduates to fill these positions. Outside influence and favoritism has influenced some of us in making these selections. The success or reputation of an instructor often depends on the men he is graduating and especially the men he selects for such mentioned positions, and in selecting these men he should consider the qualifications which he knows the man should possess successfully to fill the position. Certain positions require a commanding personality; others require men of distinct carefulness as to details; others require those who are possessed of an abundance of ambition and pushing capacity. These should be considered, and in making selections instructors should not be influenced by the opinions of others.

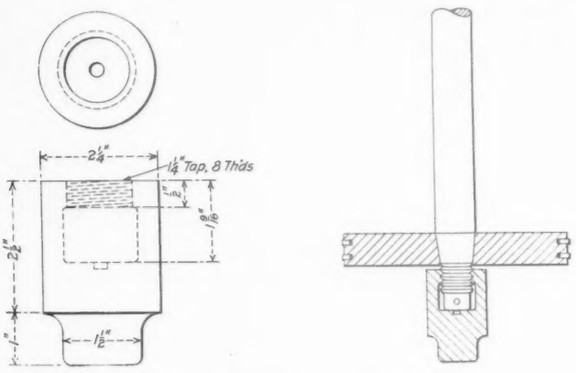
Apprentices and Graduates Leaving the Service.—The instructors were urged to go to the bottom of the matter whenever an apprentice or graduate leaves the service. Showing on the report "Left of his own accord" is not satisfactory. It is the desire of the management that the apprentice system working conditions and surroundings shall be as pleasant and agreeable to the apprentices and journeymen as it is possible to make them and equal to any other road or shop in the vicinity. The instructor should question the young men closely, and try to ascertain their real reasons for leaving. Often there are certain conditions that influence young men to leave that, if known, could be corrected, thereby removing the disagreeable feature.

[The conference also gave much time to the discussion of problems in connection with boiler shop and freight car apprentices. Reports of these parts of the meeting will be published in a later issue.—Editor]

REMOVING AIR PUMP PISTONS

BY J. A. JESSON

It is customary to use a plate and screw for removing the piston of air compressors from the piston rod, the pistons being tapped for this purpose by the manufacturers. After the device has been bolted on to the flange of the air cylinder and the screw run up against the rod, it is necessary in nearly every instance to strike the screw several blows before



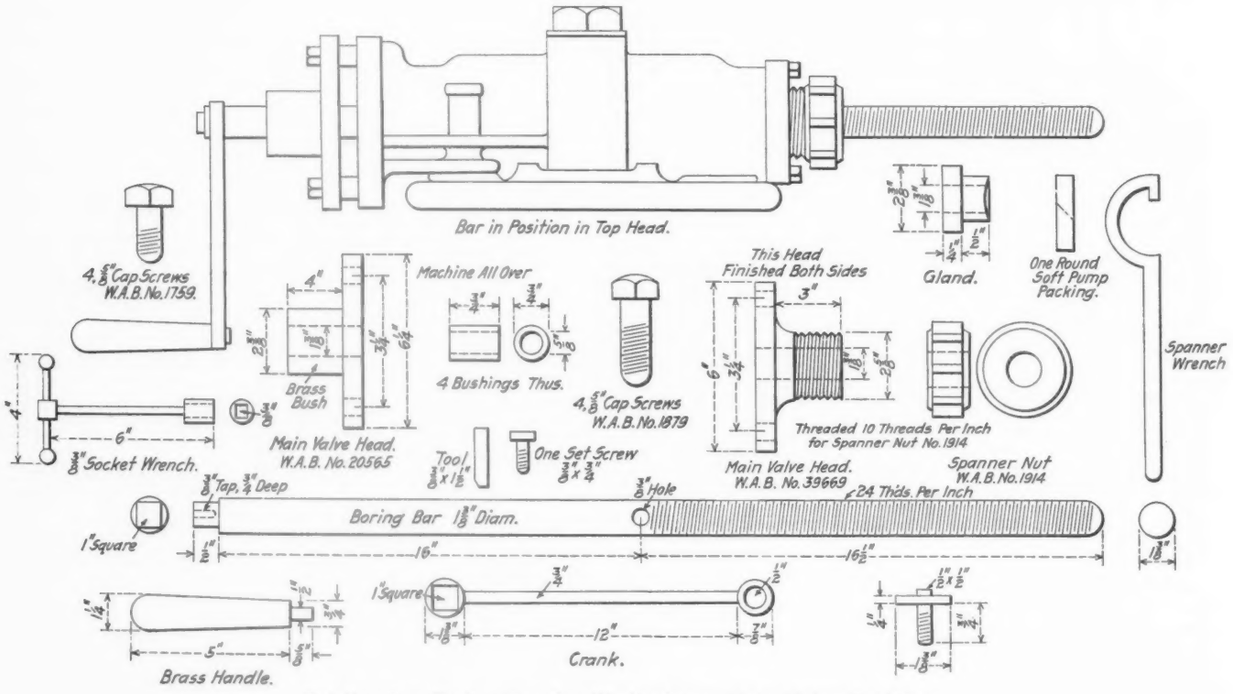
Method of Removing Air Pump Pistons

the rod will loosen. The sketch shown with this article shows a simple device which I am using for this job and by which the work can be done before the plate and screw above mentioned, could be assembled. It consists of a blind nut which screws on to the rod until it bottoms against the end of the rod, enough clearance being allowed between the base of the nut and the air piston, so that the piston rod may be loosened by a few blows against the head of the nut. As this nut bears against the end of the rod, no unusual stress is placed on the thread in the end of the piston rod and the bottom of the nut is cut away so that the original center in the end of the piston rod will not be damaged. The dimensions of the nut given are for an 8½-in. cross compound compressor. This arrangement will work equally as well on all taper rod fits.

BAR FOR BORING WESTINGHOUSE MAIN VALVE BUSHINGS

BY J. H. HAHN

The boring bar shown in the illustration is used for boring main valve bushings in Westinghouse 8½-in. cross compound air compressors. It has given excellent service and the work may be done without removing the bushing. The bar can be set up and the two bushings bored in from 30 to 40 minutes. Its use is of particular advantage at small outlying points where facilities for doing machine work are limited. The bar may be made in a few hours from discarded material. The illustration shows in detail the various parts. The boring bar itself is 1⅜ in. in diameter, being provided with a ⅜-in. hole for the boring tool located 16 in. in from the crank end. The boring bar is held in place by main valve heads adapted to this work. The head at the left has a brass bushing. The cap screws which hold this head to the body of the valve have four ¾-in. thimbles to hold it away from the valve. The main valve head on the right hand end of the valve is threaded, as shown, to receive a spanner nut. This nut with the gland above it and a piece of round fibrous air pump piston rod packing, constitute the nut through which the threaded portion of the boring bar passes as it is turned. By tightening the spanner nut, the packing is clamped tightly on to the threaded portion of the boring bar and serves as the feed nut when the bar is turned. A suitable crank and handle is provided at the left hand end of the boring bar.



Details of a Boring Bar for Westinghouse Main Valve Bushings

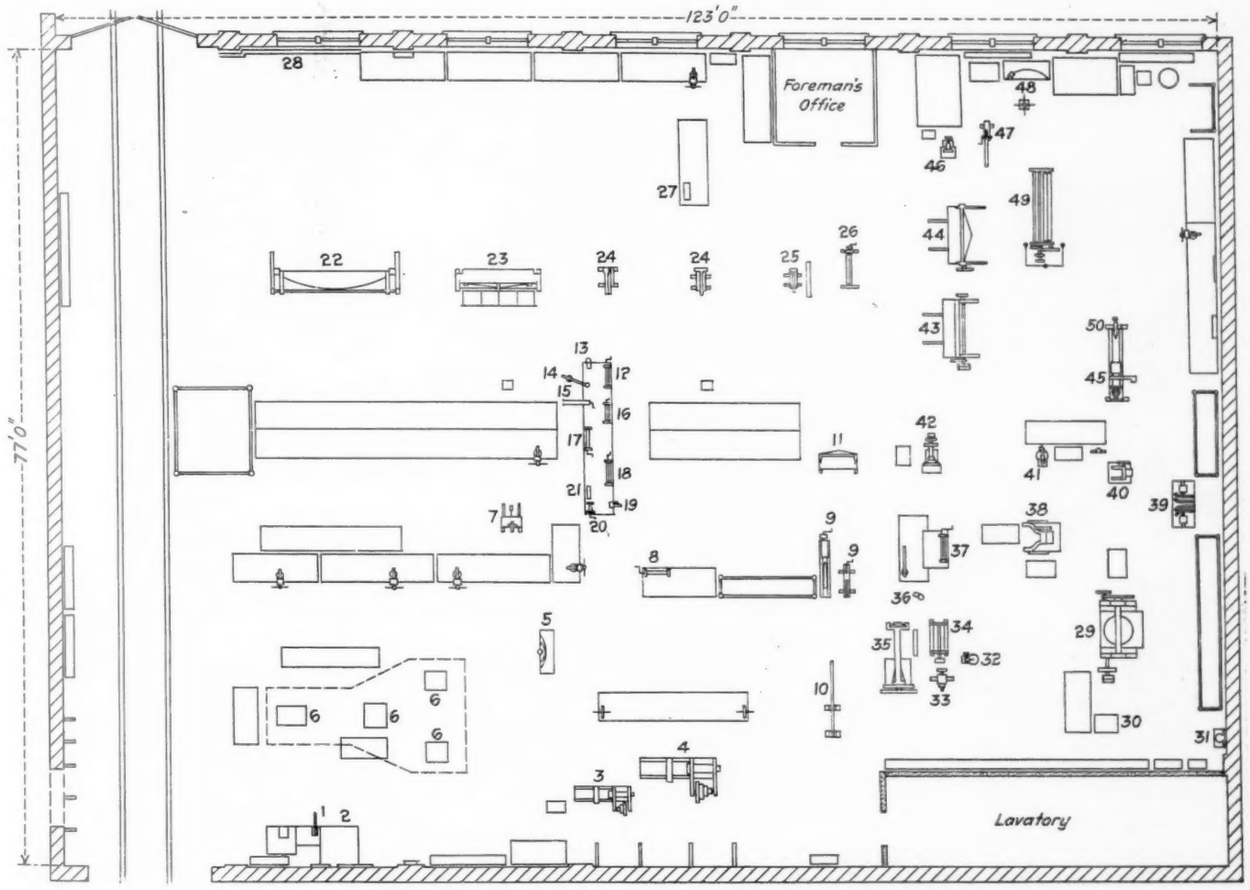
BRITISH INVENTIONS DURING THE WAR.—During the year 1916, the report of the British comptroller general of patents states, applications were filed for 18,602 new patents. The number of applications during the preceding year was 18,191.

SAVING MONEY ON RAILROAD TINWARE

Equipment and Methods of the Great Northern Shops Where Supplies for the Entire System Are Made

THE cost of the tinware used by the railroads is a large item of expense, but one which usually receives little attention. The life of the tinware used on locomotives especially is short. The service to which it is subjected is hard and there is a tendency to discard cans for minor defects which could readily be repaired. On one road which kept records of the service secured from tinware it was found that for each engine in service there were used each year seven engine torches, three tallow pots, four long spout oilers, three two-gallon cans, four one-gallon cans and one tank bucket. If we add to this the dope buckets, hot box coolers, water coolers, measures, stove pipe, etc., which are used by other departments, some idea can be gained of the great quantity of tinware required on a large system. While most roads repair tinware in the shops, comparatively few have the equipment necessary for manufacturing it. On large railway systems tinware is used in such great quantities as to justify the making of special dies and attachments and many railroad tinshops turn out work at a considerable saving over the usual prices of such material.

At the Dale Street shops of the Great Northern there is a well-equipped department which makes practically all the tinware used on the Great Northern system. This shop, which handles all the pipe work and some oxy-acetylene welding as well as light sheet metal work, is 77 ft. wide by 123 ft. long. It is equipped with a large variety of sheet metal working machinery, as shown by the list accompanying the drawing of the shop layout. Among the larger tools are a double-action Bliss press, which is used for making buckets, etc., a single-action Bliss press, a No. 3 Stiles press,



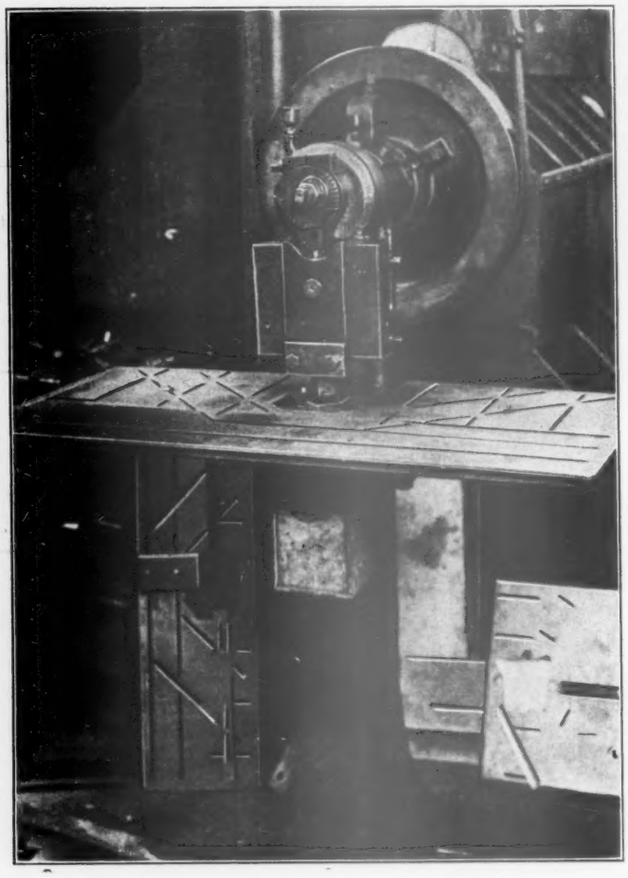
Arrangement of Tools in Great Northern Tin Shop

LIST OF TOOLS

1—Packing shears
2—Solder furnace
3—Saunders pipe machine
4—Cox pipe machine
5—Bending stand
6—Forge
7—Foot punch
8—Tinners rolls, 2 in. by 30 in.
9—Circle shears
10—Rail anvil
11—Square shears
12—Rolls, 3 in. by 38 in.
13—Punch
14—Stove pipe seamer
15—Stove pipe beader
16—Folder, 21 in.
17—Folder, 30 in.
18—Folder, 30 in.
19—Punch, 10-in. throat
20—Niagara cone roller
21—Bender, 8 in.
22—Brake, 10 ft.
23—Brake, 8 ft.
24—Niagara shears
25—Hand punch
26—Rolls, 3 in. by 48 in.
27—Tin box former, 24 in.
28—Oxy-acetylene welding apparatus
29—Bliss drawing press
30—Scarfer
31—Brake cylinder press
32—Single emery wheel
33—Stove pipe crimper
34—Stove pipe seamer
35—Bliss punch 5 ft. throat
36—Hand punch 6-in. throat
37—Rolls, 2 in. by 31 in.
38—Bliss press
39—Coach step former
40—Bliss seaming machine
41—Drill press
42—Bliss punch
43—Niagara 60-in. square shears
44—Square shears, 48 in.
45—Spinning lathe
46—Bliss punch
47—Wire straightener
48—Wire cutter and measuring table
49—Rolls, 6 in. by 8 ft.
50—Power beader

geared, a No. 1 Stiles press, not geared, power shears, and a Niles drill press. The force consists of 68 men, of whom 26 are sheet metal workers, 8 pipe fitters, 6 copper smiths, 6 acetylene welders, 16 helpers and 6 apprentices.

All sheet metal of No. 11 gage or lighter is handled in the tinshop, though most of the work is making standard tinware for the system. A fair idea of the amount of work turned out by the shop can be gained from the quantities of some of the commoner articles which are produced. During 1916 there were made in this shop 7,500 cans of various sizes, 3,500 oilers and 5,200 extra tips, 4,500 oil fonts for lanterns, 13,000 joints of stove pipe and 1,500 elbows. Many special devices have been made to facilitate any operations required in making the standard equipment. Templets of all the parts are kept on hand and the punching machines have special tables to make duplication parts easy. In one of the illustrations is shown a Bliss press fitted up for notching sheets. A number of slotted tables similar to the one shown on the machine have been designed, which make it easy to secure any spacing or to cut at any angle desired. The larger presses are fitted with many ingenious dies for forming special shapes, beading edges and doing other similar work.

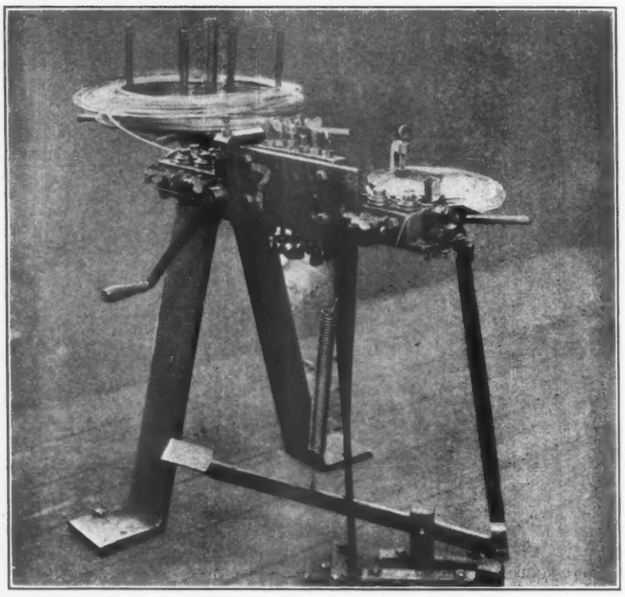


Bliss Press With Special Table for Notching Sheets

As a rule, parts formed on punch presses can be turned out at a lower cost than is possible when the same parts are cast or forged. At the Dale Street shops many parts are made in large quantities on the punch presses, such as handles, small angles, lugs for boiler jacket clamps, etc.

A handy machine which was originated in this shop is the wire straightener shown in the illustrations, which is used for forming wires for inserting in the rims of buckets, and bails for buckets and cans. As the wire is drawn through the machine it passes through a set of horizontal rollers and then through a set of vertical rollers which remove all bends in the wire. A third set of rollers is placed at the front of the machine. If it is desired to keep the wire straight these are not used, but in forming bails or other circular parts the center roller is set in until the proper curvature is secured. A guide is provided for the wire as it leaves the machine and when the stop is reached it is cut off by a pressure of the pedal.

The arrangement of the shop has been planned to facilitate the work done and many ingenious ways of saving time



A Handy Machine for Straightening Wire

have been put in practice. The tin shop is some distance from the erecting shop and a board is kept in the tinshop showing the locomotives on each pit, so that men doing jacket or pipe work will lose no time searching through the shop. In doing some of the heavier sheet work that is handled in this shop the oxy-actylene cutting torch is used. By leaving the work of cutting holes until after the parts have been formed the shaping of the sheets is often made much easier.

BABBITTING LINE SHAFT BEARINGS*

BY W. F. SCHAPHORST

A special mandrel is not necessary for babbitting line shaft bearings, and in most instances I am against such practice. I have never had a failure by using the shaft itself as a mandrel and pouring the babbitt directly around the shaft. In general, the way to do it properly is to do it quickly. Take all the time you want for preparing the molds, and prepare them in such a way that the babbitt can be poured almost instantly. By pouring quickly all sides of the shaft are heated simultaneously, expansion is the same all over, and there is no spring in one direction. The danger that must be overcome is the danger of warping, which will occur when the babbitt is poured slowly and on one spot on the shaft. That spot becomes highly heated, expands, and springs the shaft in such a way that the hot spot will be on the convex side. Before the shaft can spring back, the babbitt solidifies and holds the shaft in a bent condition. Sometimes this bend is very slight, so slight that the shaft can be turned anyway, due to the clearance allowed, but the bend can be actually "felt" with the hand, as in one position it turns easier than in any other.

*Copyright, 1916, by W. F. Schaphorst.

To prepare the shaft for the mold it is a good plan to burn some oily waste and create an oily soot on the shaft. This soot serves a double purpose. It provides the necessary clearance medium, and it is a good insulator against heat. If the soot isn't thick enough, wrap a thickness or more of thin paper around the soot. A string tied around the paper forms oil grooves that are of value in a bearing.

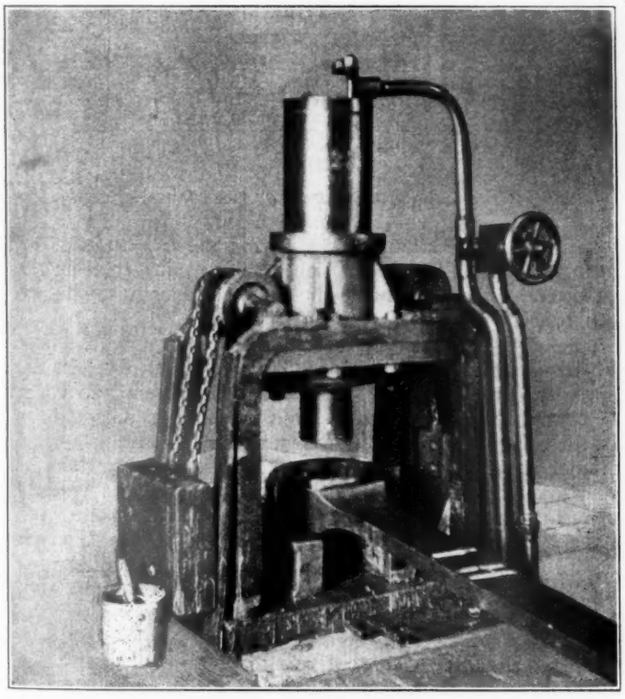
Another difficulty that attends the use of a separate mandrel is that the shaft wears with use, whereas the mandrel doesn't wear. This would give a finished job that is too loose. To avoid this difficulty, first-class millwrights make special wooden mandrels for every important job, modelling the wooden mandrel to the exact size of the metal shaft. It is well enough for manufacturers to use mandrels. But the millwright should use his own judgment as to whether or not a mandrel is necessary on special jobs or if it would pay to make one.

HYDRAULIC PRESS AND PUMP FOR ROD BUSHING WORK

BY HARRY KING
Foreman, Machine Shop, Norfolk & Western, Portsmouth, Ohio

The photographs show a hydraulic press and pump which was made in the Norfolk & Western shops at Portsmouth, Ohio. The press has a capacity of 75 tons and is used for stripping and pressing in side rod brasses and work of like nature.

There is a space of 24 in. between the housings and 14 in. clearance under the ram. The bottom or base plate is a steel slab 3 in. thick with a 12 in. hole in the center for clearance when used in stripping. The housings or yokes



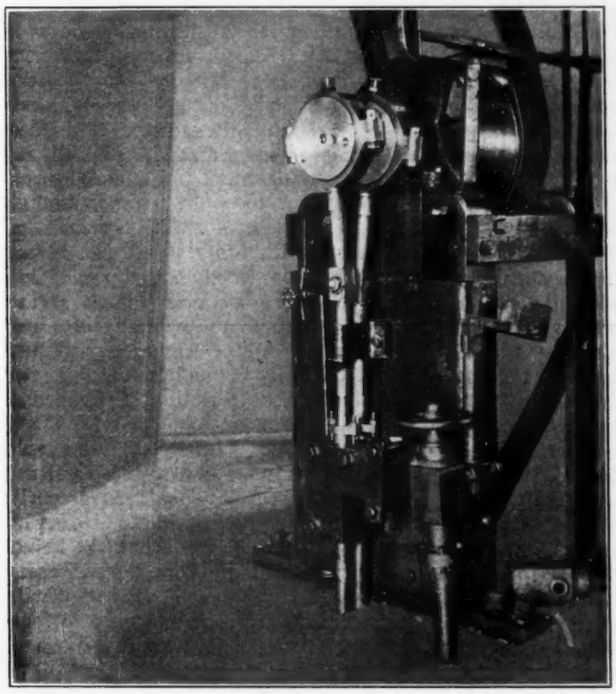
Hydraulic Press for Applying and Removing Rod Bushings

are of 2½-in. square steel and are turned 2½-in. in diameter where they pass through the base plate. The body casting is an old truck center casting planed on each side to accommodate the yokes and bored to fit the cylinder, which is of steel and is pressed in from the bottom.

The cylinder is turned with a collar on the bottom end which rests against the lower face of the body casting. The cylinder has a 6-in. bore and is threaded at the top for a 6½-in. plug. The piping on the press is of 1⅛-in. by 1¾-in. steel tubing. The valve is attached to the feed line by a tee which gives control of the press without having to stop the pump.

This press has been found to be far more satisfactory for this class of work than a pneumatic press. The movement of the ram is steady both in stripping and in pressing in brasses, where a pneumatic press has a tendency to jump and therefore is dangerous.

The pump is mounted on a frame of 1-in. by 4-in. iron and is driven with a 5-in. belt on an 18-in. pulley. The



Pump for Operating the Hydraulic Bushing Press

eccentrics are 7¾ in. in diameter and are forged solid on a 2½-in. shaft. The small plug is ⅞ in. in diameter, the larger one 1½ in. in diameter, both having a 3-in. stroke. The body of the pump is of steel, bushed with brass where rust would cause trouble.

The tank is set directly under the pump below the floor line. The ¼-in. pipe shown on the left of photograph of the pump is tapped into the suction pipe of the larger plunger and is used for backing the vacuum on the large side where the pressure gets to about five tons.

The safety valve is set at 25 tons, which is all that is needed, and the pump runs at 150 revolutions per minute.

SUGGESTIONS FOR LOCOMOTIVE ROD WORK*

BY GEORGE TWIST
Division Master Mechanic, Canadian Pacific, Medicine Hat, Alta.

Locomotive rod repairs may be divided into two classes: main shop repairs and running repairs. In the first case it is assumed the shop is provided with up-to-date devices for handling the rods with the least amount of manual labor, such as overhead cranes and power presses. The rod department or gang should be located in the best adapted portion of the shop, convenient to transfer tracks and overhead cranes, and should be equipped with the necessary machinery,

* Entered in the Rod Job Competition.

such as shapers, lathe, drill presses, boring mills, power hack saws, etc., which are distinct from the other part of the machine shop. By this I mean that all the work pertaining to the complete fitting of the rods should be done in the rod gang, without the necessity of having bolts turned or brasses fitted at a distance.

Before stripping the rods all brasses should be examined by the foreman in order that serviceable brasses will not be wasted. The rods and straps should then be taken to the blacksmith shop and heated in order to detect flaws and to anneal the metal. The rods should at this time be made to the proper length to avoid the practice which I have known to be followed, of boring the brass eccentric in order to obtain the proper length. This is a bad practice and often the cause of trouble in running repair shop on account of the brasses being replaced with brasses finished true both inside and out, the man making repairs not knowing the brasses were bored in off center, but thinking they had worn this way. The crank pins should be examined and trued and the brasses fitted. Solid brasses should be bored out 1-64 in. larger than the pin. The crank pin and crosshead pin brasses, which are mostly of the split type, should be fitted neatly in the strap. A piece of sheet iron 1-32 in. thick should be placed between the brasses and the brasses should then be bored 3-64 in. larger than the pin. This will allow ample clearance at the top and bottom of the brass and will do away entirely with the necessity of filing the brasses to fit the pin. I have seen a first-class machinist take three or four hours to carefully fit the brasses, and even then they have run hot, but with the method mentioned I have yet to see the first brass give trouble.

After boring out the straps they should be put on and the rods' bolt holes should be examined and reamed, and the taper bolts carefully fitted. These bolts should be properly secured with nuts and an approved type of lock nut or split key. When the rods are being put up they should be keyed "brass to brass" and no draw allowed. Crank pin brasses fitted in this manner will not loosen in the strap and it will not be necessary to take them down more than once in four to six months, providing the driving wedges are not allowed to run loose and the engine is otherwise cared for.

As most roads today are using grease, it may be desirable to give the method of grooving the crank pin brasses. Fig. 1 shows one which has given good results. It consists of a cavity 3/8 in. wide and 1/4 in. deep extending to about 1/2 in. from each end of the brass and connected to grease hole with

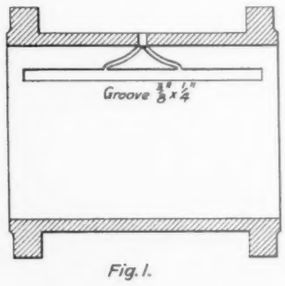


Fig. 1.

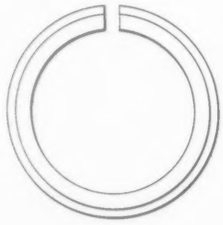


Fig. 2.

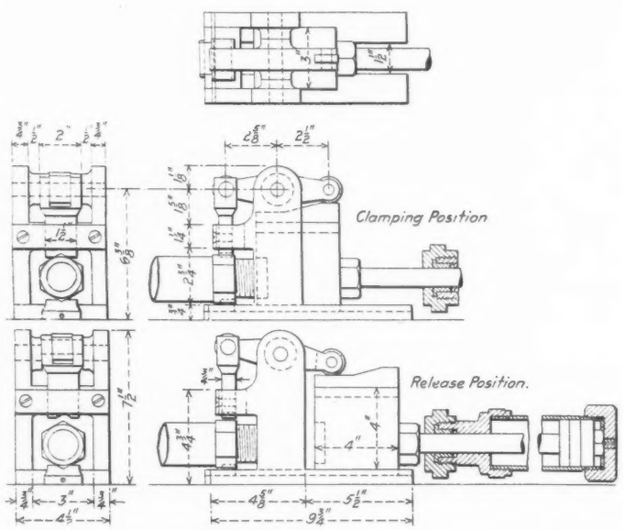
two short leaders. This is done to both halves of the brasses. Rods made up in the manner mentioned, put up to the proper length, keyed securely and given the necessary attention by the enginemen will give little trouble.

With regard to the maintenance of the rods in the running repair shop: Solid brasses which are worn but not sufficiently to be scrapped should be cut in a shaper (see Fig. 2), lined up and pressed into the rod, allowance being made for reboring to 1-64 in. larger than the pin. The results from a brass replaced in a rod in this manner are equally as good as from a new brass, and the present price of new brass requires that this practice be seriously considered. Crank pin brasses should be taken to the shaper and stripped off sufficiently to allow for reboring in the same manner as mentioned in main shop practice. Crosshead brasses rarely require any work other than reducing them to the size of the pin, and the proper method would be to do this in the shaper. With the facilities for handling rod work quickly the above methods will give good results when the proper care is given to them by enginemen.

HOSE TESTING MACHINE

BY F. OSBORNE
Millwright Foreman, Canadian Pacific, Winnipeg, Man.

One of the old methods used to test air, signal and steam hose after repairs have been made is to screw a cap on the end of the hose nipple and couple up the other end to the shop air line. The air was then turned on and the hose placed into a water tank to find the leaks. This method



Clamp for Holding Nipple End of Hose While Testing

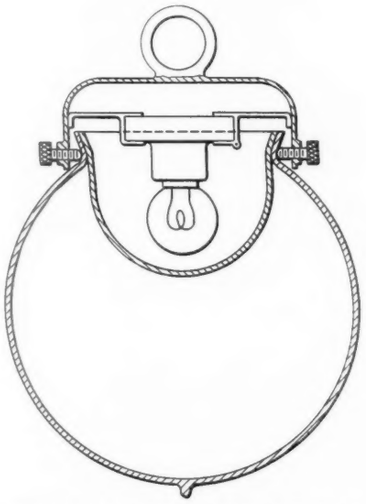
took up a great deal of time screwing the cap on and off, and very often air escaped through the cap joint, spoiling the test and also inconveniencing the operator, as the hose had to be re-tested.

A more successful and quicker method for testing the hose is used at the Winnipeg shops of the Canadian Pacific, the simple device shown in the drawings being used to cover the clamp end of the hose. This machine is operated by air, the principal parts being the frame, crosshead and 3-inch cylinder operated by a 4-way cock. The crosshead top is fitted so as to take different sizes of wedges, which are easily changed to test various types of hose. Attached on the front of the crosshead is a piece of rubber of 2½ inches diameter and 1 inch thick. The frame contains jaws similar to a pipe vise, the upper one of which is operated by the clamp lever. The hose nipple end is placed in the frame and the air is turned on, causing the crosshead wedge to push up the lever and close the clamp gripping the hose nipple. The crosshead still continues its travel and the lever roller runs on to the flat spot on the wedge, which allows the rubber to close the end of the hose nipple, making an air-tight joint. The other end of the hose is coupled up to the shop air line and tested. Any leaks are noted by use of soapy water applied with a brush, thus doing away with the use of a water tank. After the test the air is turned off and the hose is released. This machine is a bench fixture and by its use makes the test more efficient, and further, the amount of labor is reduced considerably.

DODDS' COLD STORED LIGHT

Light and heat are so closely associated that it is difficult to think of the former as being unaccompanied by the latter. In many cases the heat thrown off by the light is a disagreeable feature; in some cases it is extremely inconvenient—sometimes even dangerous. The firefly gives off a considerable amount of light, but with very little or no heat. Apparently it stores up the light during the day time and gives it out at night, somewhat as a storage battery stores and gives out electricity. If this storage of light could be accomplished on a commercial scale it would seem to have tremendous possibilities in the conservation of coal and other fuel, thus greatly cheapening the cost of lighting.

Ethan I. Dodds, associated in an engineering capacity with the Flannery interests at Pittsburgh, accidentally discovered a



Dodd's Cold Stored Light Apparatus

means of storing light while experimenting on an appliance to enable the blind to see shadow pictures through the use of radium. The arrangement of one of the experimental types of the cold stored light unit is shown in the illustration. It consists of double glass globes, the inner surface of the outer globe being coated with the light retaining element. The secondary globe is sealed in the mouth of the outer one and is, of course, transparent. When light is flashed from any source whatever it is absorbed by the inner surface of the outer globe. More effective results are obtained, however, when the light which is flashed is placed in the secondary globe as shown in the sketch. When an ordinary incandescent bulb is used a mere flashing of the light will allow the outer globe to absorb a sufficient amount of light so that it will glow and give off a considerable amount of light for a period of ten or fifteen minutes.

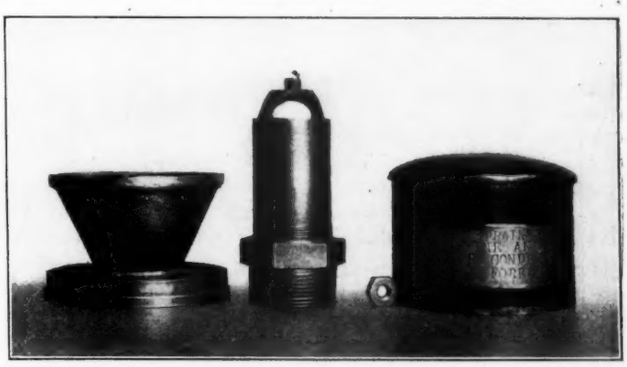
While the device as it has been thus far developed will not throw a strong light, it will illuminate a dark room sufficiently so that one can readily find his way about. It is expected, however, that as the device is further perfected it will be possible to give off a much stronger light.

Marconi, the Italian inventor, has become very much interested in the device and is developing a wireless sparker which can be used in place of the incandescent bulb which is illustrated. In this way, for instance, it might be possible to maintain these lights without any wiring apparatus for subsea lighting in order to enable ships to find their way safely through dangerous channels. Or it might be possible in case of an explosion in a mine to maintain the dim light underground when the power connections had been cut off, by means of the cold stored lighting bulbs used in connection with the wireless apparatus.

It is quite possible that numerous applications may be found for this light in railway service when it has been completely developed. For instance, a dim light which did not throw off heat would prove most acceptable in the berths of sleeping cars during the summer months. It might also be used to good advantage in the subways or tunnels, where a strong light was not necessary. If the outer shell of the stored light globe was used in the same way as a frosted or sanded globe for ordinary lighting it would insure a dim light for 15 or 20 minutes if for any reason electric current was cut off.

AIR PUMP STRAINER

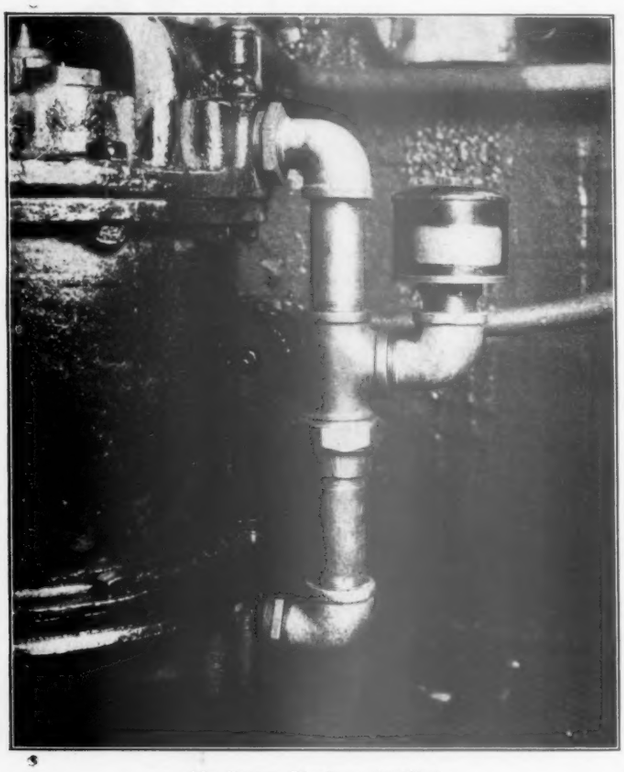
A new type of air strainer has been invented and patented by N. T. Cline, air brake foreman of the Pittsburgh & Lake Erie at McKees Rocks, Pa. It is shown in the illustrations attached to an air compressor and unassembled. The



Parts of the Air Pump Strainer

strainer consists of a central tube which screws directly into the suction of the pump. This tube has an opening at the top, as indicated, and on it is screwed an inverted strainer which is held in position by a lock nut. On top of this is

placed a protective casing which covers the top of the strainer and protects the sides from damage. In this way the air comes in under the protective casing up through the strainer, over the top of the center casing and into the air compressor. With this construction there is less liability for water to be



Air Pump Strainer Applied

drawn into the cylinder and also for the dirt to adhere to the strainer as it will fall by gravity. This strainer contains 4½ sq. in. more area than is common with the standard strainer furnished with the compressor and it occupies the same amount of space. It has been applied to heavy Mikado engines which handle long trains, and has worked successfully.

THERMOSTATIC METAL

The General Electric Company, Schenectady, N. Y., has perfected a new product designated as G-E Thermostatic Metal which takes a curve or regains its original straightness in accordance with well defined laws as the temperature rises or falls. As a result of this responsiveness to temperature change and the mechanical force developed, this metal is used to actuate various mechanisms which tend to neutralize either the temperature change or its effect upon devices.

The metal is made up of two strong non-corrosive metals possessing a wide difference in co-efficients of expansion, the widest difference possible for any known stable combination of metals. These two metals are firmly attached to each other throughout their entire length so that there is absolutely no slip of the one upon the other. Thermostatic metal can be cut, stamped or pressed into practically any desired shape, and when annealed will have all its original inherent qualities; moreover, it will not deteriorate nor take permanent set under applications of heat or force within definite practical limits. The metal is manufactured in various standard thicknesses ranging from 0.25 to 0.015 in.; the maximum width is 4 inches and the maximum length is 36 inches.

This metal can be used for temperatures as high as 500 deg. F. The deflection per degree temperature change besides being quite considerable as shown by Fig. 1 is a constant for any definite piece of the metal, and since a definite and considerable opposing force is necessary to cause the metal to take permanent set (see Fig. 2), the metal can be depended upon when used in devices where extreme accuracy is rquired.

If the curving of this thermostatic metal on heating or cooling is opposed, the metal will produce a mechanical force (see Fig. 3), which is limited only by the force required to produce permanent set. For example, Fig. 3 shows that a piece of thermostatic metal 0.1 in. thick, 5/16 in. wide and 4 in. long will exert a force of 24 ounces (1½ lb.) on being restrained from bending when subjected to a temperature change of 100 deg. F. This curve illustrates the laws that the force exerted by this metal varies as the square of the thickness, directly as the width and as the square of the temperature.

The length and thickness of the metal alone affects the deflections of the metal, the width of the piece having no in-

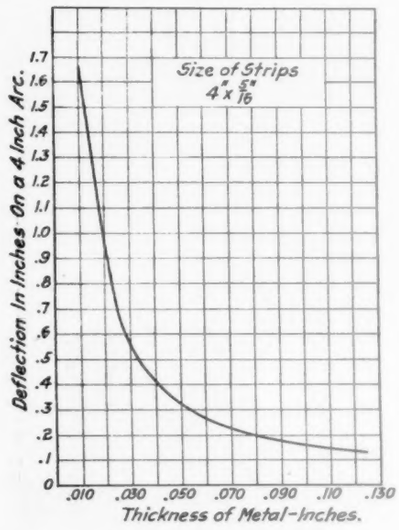


Fig. 1—Deflections Caused by a Temperature Change of 100 Deg. F.

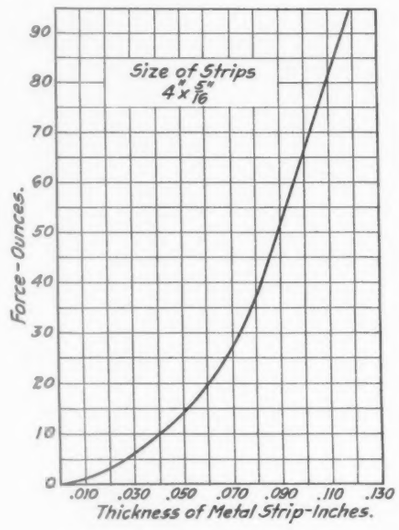


Fig. 2—Force Required to Give Permanent Set

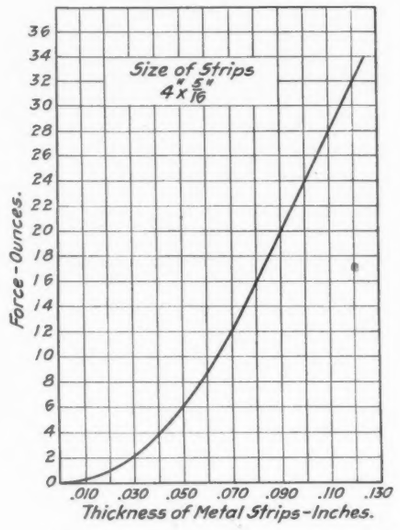


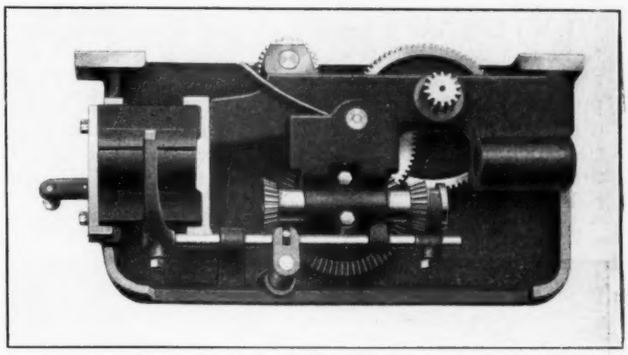
Fig. 3—Force Exerted by Metal Strip at 100 Deg. F.

fluence. From these curves it will be found that the deflection for any given temperature change varies directly as the square of the length of the piece of thermostatic metal and inversely as the thickness of the piece. As previously pointed out, the deflection of any piece of metal varies directly as the temperature change.

This metal is used in the products of many different industries owing to the fact that it can be successfully worked into different shapes and forms. In some of its applications it is used to actuate mechanisms directly by means of the force developed within itself when its tendency toward assuming a curved shape is restrained. In other applications it is used to close and open the contacts of electrical circuits by means of which various devices are operated.

NATIONAL GEARED HEAD LATHE

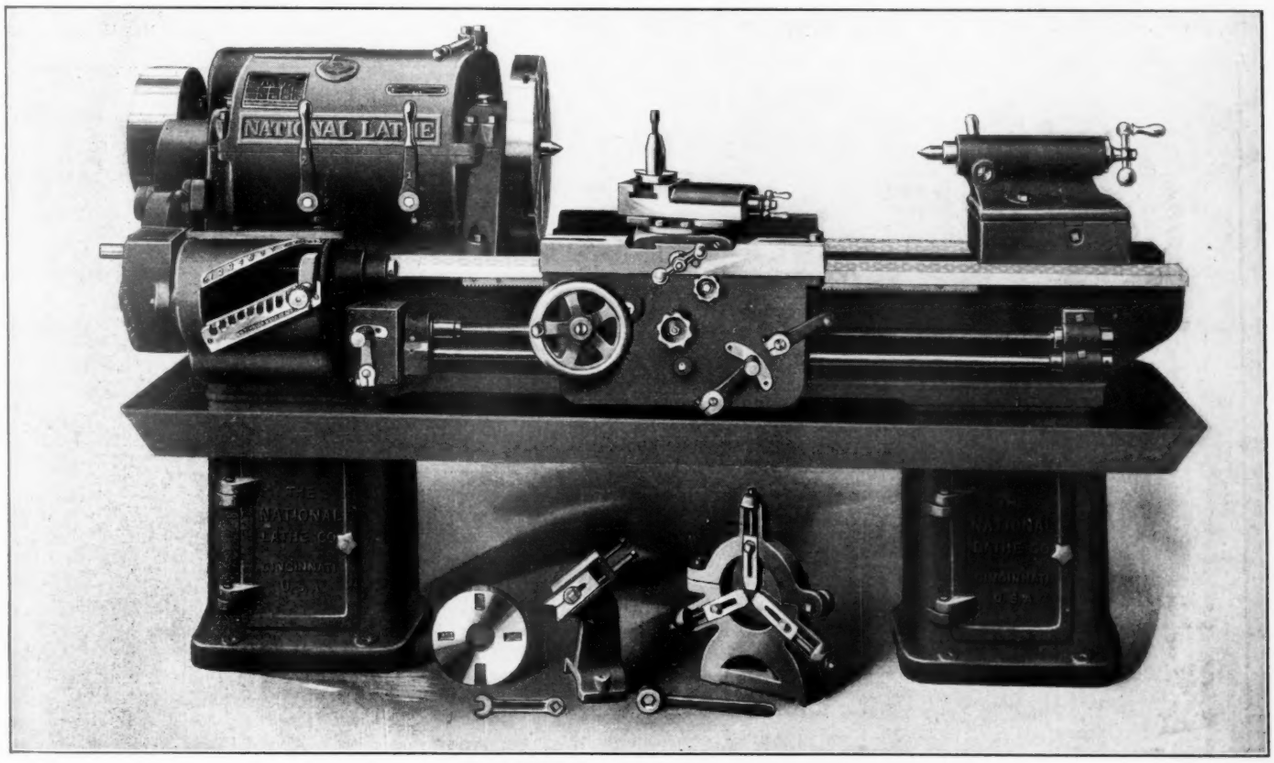
The National Lathe Company, Cincinnati, Ohio, is constructing 18-in. and 22-in. high duty lathes for either motor or belt drive. These lathes are designed with particular care to rigidity, accuracy and simplicity. The bed is of heavy, deep section, well braced for its entire length. The geared head is particularly designed for heavy work and provides eight spindle speeds, forward and reverse, with a double friction countershaft. The speed reductions of the gears are 28 to 1. Either alternating or direct current constant speed motors can be used, they being bolted to the bed plate mounted on the head of the lathe. The connection between the motor and the geared head is made by means of three spur gears. The speeds provided range from 12 to 330 r.p.m.



Double Wall Apron for the National Lathe

The apron body is a solid casting of box section with outboard bearings for all shafts and studs. The gears are made of .045 and .065 carbon steel. The feeds are located conveniently for the operator and an interlocking device prevents the engagement of the screw and the feed at the same time. The screw cutting arrangement is of the quick change type, all threads being obtained by the movement of one lever. From 3 to 64 threads per inch may be obtained on a standard lathe. The lead screw is made from special ground lead screw stock and is 1 5/16 in. in diameter. The maximum variation allowed in chasing is .001 in. per lineal foot. Standard or metric lead screws are furnished as desired. A large number of cutting feeds, both longitudinal and transverse, are provided. The feed rod is gear driven and the range of feeds is from .006 in. to .128 in. per revolution of the spindle.

The compound rest is rigidly constructed, being fitted with full length tapered gibs with end adjusting screws. The swivel is circular and graduated in degrees. The tailstock is of the offset type which allows the compound rest to be placed parallel to the bed. It is provided with set-over screws for taper work. The carriage is gibbed to the bed at both the front and back and has an extra wide bearing for the slide rest with a large vee at the front and back.



National Heavy Duty Geared Head Lathe

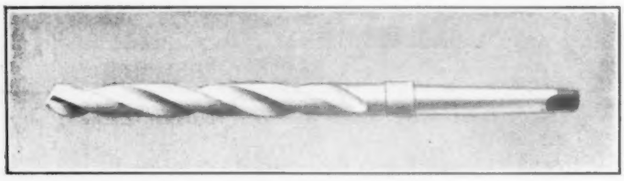
The following are the general dimensions of these lathes: Swing over bed 18½ in. and 22¼ in.; swing over carriage

slide 12⅜ in. and 16¾ in.; diameter driving pulley 12 in.; width of belt 4 in.; length of carriage bearing 22½ in.; width of cross slide 7¾ in.; distance between centers (6-ft. bed) 38 in.; Morse taper No. 4; width of top of the bed 14 in.; net weight, 6-ft. bed, motor drive, 3,200 lb.

FORGED TWIST DRILL

It has long been a question whether or not it is possible to forge a twist drill from a solid piece of steel in a manner which would be commercially practicable. Various processes have been developed for making a so-called forged drill, but they have involved the twisting of a flat bar of steel to form the drill. These processes have not been entirely satisfactory in the structure and strength of the material produced.

A process of twist drill forging has been developed by the



Russ Twist Drill With Forged Flutes

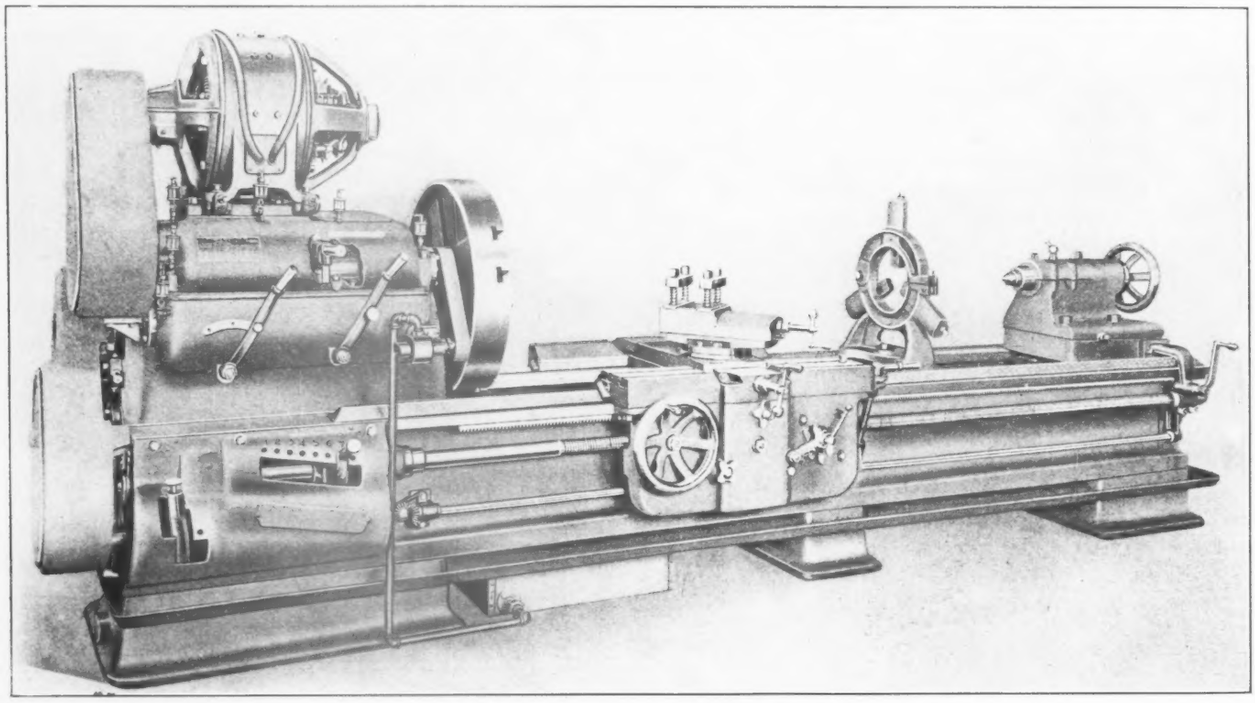
A. E. Russ Forged Drill Company, Cleveland, Ohio, which is claimed to produce a drill of much improved structural quality. A round bar of steel is first forged down to the required size, after which it is again forged to form the flutes. This process not only makes a close grained structure, but the flow of the metal caused by the forming of the flutes is forced to follow the spiral of the drill, instead of running straight from end to end, as it does in a milled drill.

The increased strength which is thus obtained is said to make practicable a higher speed and more rapid feed than is possible with a milled drill.

HEAVY ALL-GEARED HEAD LATHE

The lathe of exceptionally heavy construction that is shown in the illustration is made by the Pittsburgh Machine Tool Company, Braddock, Pa. This lathe has an all-geared head, which provides 12 spindle speeds ranging from 6.2 to 220 r.p.m. It has a 32-in. swing over the ways and a 21-in. swing over the carriage. The distance between the centers is 5 ft. The headstock is of the enclosed type, and is so constructed that the lathe may be easily dismantled. The speed changes are obtained by two clutches and three tumbler gear shifts. The engaging gears on the tumbler shaft and the clutches are casehardened. The main spindle is made of hammered steel, being ground to size. The front spindle bearing is 6 in. in diameter and 8 in. long, and the rear spindle bearing is 4 in. in diameter and 6 in. long. There is a 2⅜-in. hole through the entire length of the spindle.

The tailstock is of extra heavy design, being provided with a 4-in. spindle. It has a pawl which engages in a rack cast in the center of the machine bed. It is moved by gears and is held to the ways by four large binder bolts. The carriage is of heavy design, and has a bearing on the ways of 44 in. It has a compound rest of heavy construction. The bridge of the carriage is 12 in. wide. The apron is of an entirely new design and of exceptionally heavy construction, being equipped with steel gearing, with the exception of the friction gears, which are made of semi-steel. All the studs in the apron are hardened and ground. A quick change feed is supplied with the lathe for either English or metric thread. The metric pitches that can be cut vary between 0.5 and 15, and the English standard threads vary between 1 and 32. There are 36 feeds provided with this machine.



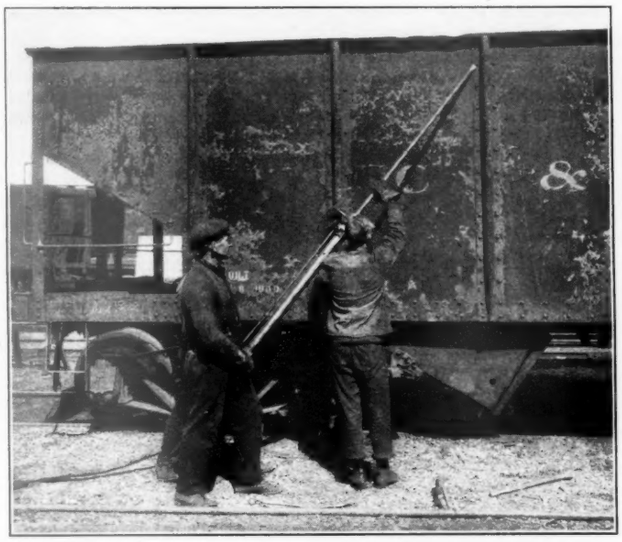
Pittsburgh 32-in. All-Geared Head Lathe

The bed is of heavy design, being 29 in. wide by 20 in. deep. A taper attachment of rigid construction is provided with the machine. Motor drive can be supplied with either alternating or direct current motors. A 6-in. belt is supplied between the motor and the lathe with an automatic belt tightener, or a silent chain drive can be supplied. Where a

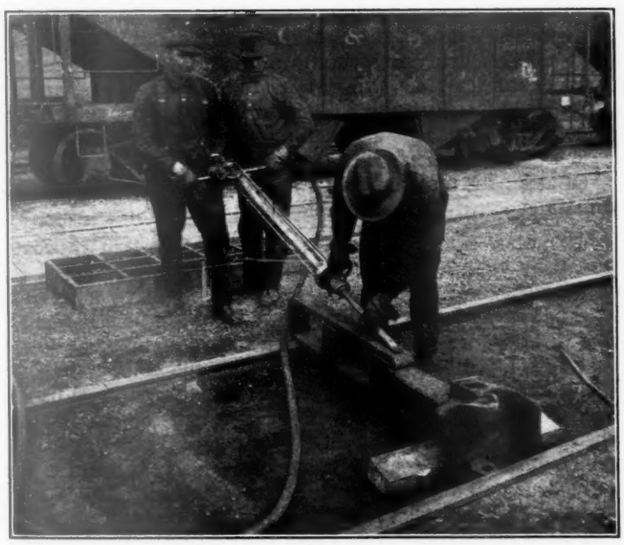
countershaft is furnished, it is of two-speed construction and either tight or loose pulleys or a clutch countershaft can be furnished. The net weight of the lathe with a 12-ft. bed is 14,000 lb.

RIVET CUTTING GUN

With the large number of steel cars now in service, an important factor in their repair and reconstruction, is the cutting of rivets. The inaccessibility of many of these rivets makes their removal more or less awkward when the work is done with a sledge and chisel. The Rivet Cutting Gun Company, 220 East Second street, Cincinnati, Ohio, has developed a device for cutting rivets that has been found very serviceable in steel car work. With it is provided a long cutting bar for use on the sides of cars and in inaccessible places underneath cars, in fact, the machine can be used wherever a rivet is to be removed. A punch is also provided to knock the rivets out after the heads have been cut off. The illustrations show how it is used for cutting rivets from the top of gondola cars, a 5-ft. bar being used in this case.



Rivet Cutting Gun Being Used on Gondola Cars



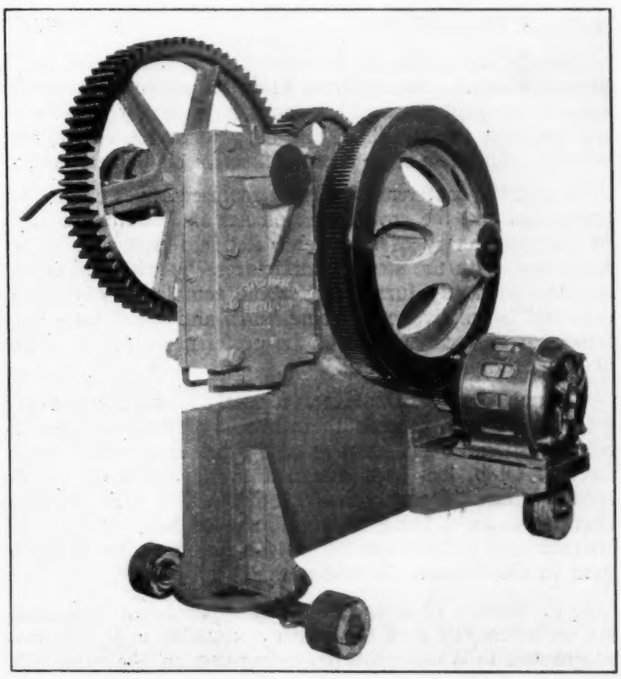
Rivet Cutting Gun Removing Rivets from Drawbars

This eliminates the necessity of scaffolding and provides a quick means of removing the rivets. The second illustration shows the rivet gun being used for cutting 1¼-in. steel coupler yoke rivets. In this case the work is done in the yards, it being unnecessary to carry the coupler to any machine. This machine is also used for straightening bent plates on steel cars and in punching holes for various purposes.

The device weighs 71 lb. and is usually handled by three men, as indicated in the illustrations. It has been in use on one railroad for over a year where it has been found that three men with this tool can cut off 4,000 rivets in nine hours, which with a sledge hammer and bar would require four men four times as long. It is also reported that in working on a high sided steel hopper car, which was wrecked, involving the removal of the center sill and attachments, the coupler, the hopper doors and all air attachments, 1,143 rivets of from ⅝ in. to ⅞ in. in diameter were cut off and backed out in 7¾ hours. This rivet gun can be operated with an air pressure of 55 lb., but 75 to 100 lb. is recommended for heavy work.

PORTABLE MOTOR DRIVEN SHEAR

The Buffalo Forge Company, Buffalo, N. Y., has recently placed on the market a motor driven shear which is mounted on small wheels so that it can be moved to various parts of the shop. This shear is designed to cut flat iron of 1⅛ in. by 5 in., 1¾-in. round iron, 1½-in. square iron and 5-in. by 9/16-in. angles. The frame of the machine is built up of 3½-in. armor plate. The plungers and flywheels are of good size and the bearings are extra long, being provided with bronze-bushed oil ring bearings. It is provided with double back gears. The gears are cast iron and the pinion is steel. The machine is provided with a jaw clutch and a cast iron plunger guide. A 15-hp. motor is shown in the illustration for driving the machine, but it can also be furnished for tight and loose pulley drive. The machine shown in the illustration is the largest of four sizes made by this company.



Portable Armour Plate Motor Driven Shear

Railway Mechanical Engineer

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WE GUARANTEE that of this issue 9,600 copies were printed; that of these 9,600 copies 7,918 were mailed to regular paid subscribers, 114 were provided for counter and news companies' sales, 297 were mailed to advertisers, 192 were mailed to exchanges and correspondents, and 1,079 were provided for new subscriptions, samples, copies lost in the mail and office use; that the total copies printed this year to date were 82,347, an average of 9,150 copies a month.

THE RAILWAY MECHANICAL ENGINEER is a member of the Associated Business Papers (A. B. P.) and the Audit Bureau of Circulations (A. B. C.).

The Baltimore & Ohio, like the Pennsylvania, has called to the service of the company considerable numbers of retired employees.

The article on repairing main and side rods which was published in the August issue of the *Railway Mechanical Engineer* on page 457 was written by Millard F. Cox, assistant superintendent of machinery, Louisville & Nashville Railroad, Louisville, Ky.

The Atchison, Topeka & Santa Fe has announced an increase in wages, ranging from 11 to 15 per cent, to car and locomotive employees. This increase is in addition to the ten per cent bonus which will be paid at the end of December. The new scale became effective on September 1.

During the conferences between representatives of the steel companies and the government officers in Washington early in July, Secretary of Commerce Redfield perfected an arrangement with the steel manufacturers by which steel will be more promptly furnished for the completion of railway cars and locomotives now being built, and which have been somewhat delayed because of the preference given to orders of the government for steel.

Colonel Charles D. Hine, formerly vice-president and general manager of the Southern Pacific of Mexico, and more recently special representative of the president of the Baltimore & Ohio, has been assigned to the command of the 165th regiment, formerly the 69th of the New York National Guard. Colonel Hine is a graduate of West Point. He later entered railway service, but became a major of volunteers in the Spanish-American war.

J. F. Stevens, chairman of the railroad commission making an investigation of the railway situation in Russia, has telegraphed to Washington requesting that an American railway unit of 129 men, consisting of division superintendents, despatchers, trainmasters, engineers, master mechanics and one telephone expert, be despatched to Russia to educate the Russian railway men in American operating methods. The request has been referred to S. M. Felton, director general of railways.

Under the direction of the Railroads' War Board, every road in the United States is taking a census of the men employed by it, with a view to assisting the government in determining who should and who should not be exempted from military service. The census will show the men who are married and those who are not, with details as to those dependent upon the married men. A second classification will show those who can be replaced either by men inexperienced in railroad operation, or by women, and who therefore may be relieved from the service without embarrassment. The railroads will make direct application to the exemption board for the exemption from military service of all employees who, as shown by the list and affidavits, should be released from military duty under the terms of the selective service law.

At the recent annual meeting of the American Society for Testing Materials it was decided that the tentative standards shall be published in the proceedings as heretofore, and the executive committee was requested to take such action as it saw fit with regard to their separate publication. In accordance with this action the executive committee has decided that, in addition to the publication of the tentative standards as Part I of the proceedings, they will be reprinted in a separate pamphlet in a paper binding. Each of the standards will also be reprinted separately so that those who desire copies of individual standards can secure them in that form. The paper-bound book for 1917 will comprise about 325 pages, and in addition to the 60 tentative standards, will contain the complete list of standards and tentative standards of the society, with a suitable index. The price of this publication has been fixed at $2 for members and $3 for non-members. The volume is expected to be available about October 15.

The wage controversy between the southeastern railroads and their 25,000 federated shop employees, which has been in progress since February 20, has been settled, by a decision of Secretary of Labor William B. Wilson, to whom it was referred, after mediation by a representative of the department had failed. An agreement embodying the final details of the settlement was signed on August 24. Secretary Wilson's decision provides for an increase of 8½ cents an hour to mechanics and specialists, and 6½ cents for all other men represented. The railroads had previously agreed to give the eight-hour day and 6 cents an hour. Car inspectors and repairers, train car repairers, train air brake repairers, safety appliance maintainers, oilers and packers and all others employed in the car department, and for whom an eight-hour day had not already been agreed to, under the decision will have their basic day reduced two hours per day, but in no case shall the basic day be less than eight hours nor more than ten hours a day, and they shall be paid time and one-half for overtime as per overtime rules already agreed to. The

increases in wages, it is estimated, will cost the railroads about $8,000,000 per year.

Delays in Repairing Freight Cars

Fairfax Harrison, chairman of the executive committee of the A. R. A. committee on national defense, has issued a circular, "Bulletin No. 27," calling the attention of railroad managers to the large amount of unnecessary delay in repairing foreign freight cars. When a railroad car shop repairs a freight car belonging to another road, and has to send to that other road for material, it has to bear not only the cost of the per diem charge on the car while it is waiting, but also the loss of the car in service; and in the present scarcity of cars this is a serious item. One large railroad found that there was an average delay of 14 days, from the date of its orders for material from owners, to be used on foreign cars, to the date the material was shipped; and a further delay of 31 days (average) from the time the material was shipped until it was received. These figures probably show the general average throughout the country.

Attention is called to the fact that the Master Car Builders' rules permit the use of unstandard parts under certain conditions, provided the car can be made safe and serviceable; and the association has recommended and urged members to take advantage of this provision of the rules. Where it is necessary to use metal bolsters, large castings or other parts for which non-standard material cannot be substituted, car owners should take care to ship material with the utmost promptness.

Railway Engineers in Battle with Submarine

Letters from members of the Rock Island and Illinois Central companies of the Thirteenth Engineers (Railway) United States Army, indicate that the vessel which carried them to Europe had a lively battle with a German submarine shortly after the war zone was entered. A letter received by a relative of a member of the Rock Island company described the battle in detail: "Sunday at 7 a. m. a 6-in. gun was fired, followed by a 4-in. gun. I did not think of the danger we were in until a shot hit the water about 20 ft. from the left side of the boat. It was a submarine firing at us from the rear. Some of the boys claim they saw the U-boat, but the submarine was too far for me to see with the naked eye. I did see the flash from her guns, but could not hear a report. You can imagine, she was pretty far away. One of the gunners claimed that three shots went over the ship between the funnels and the bridge. The captain sent out a wireless for help and telephoned to the engine room for more speed ahead. The fight lasted 34 minutes, and during that time our gunners fired 34 shots. The 'sub' evidently fired more, for the shots hit the water all around us. At 9 and 9.15 we passed two English ships with one gun each on the stern and signalled them of the danger ahead. Between 11.30 and 12 o'clock we picked up a wireless message that one ship was sunk, but the other got away from the submarine."

Railway and Engineering Work in France

The value of railroad materials and rolling stock alone, now being purchased to provide in advance for the needs of the American army abroad, is about five times that of all purchases made annually in this country for the Panama Canal during the last four or five years, according to a statement authorized by the chief of engineers of the army.

Our engineers will equip the wharves and piers in France utilized by American forces with the terminal facilities required by our armies. The lumber for this work will be cut from European forests by regiments of American foresters. This method will save burdening our ships with lumber from the United States. One regiment of foresters is being organized, and several more will be raised. They will carry with them complete lumbermen's outfits, including sawmill equipment.

Material for extensive standard gage and narrow gage railroads will be sent to Europe, to enable the engineers to carry out their task. The lines to be built will both transport our troops to the front and handle all transportation behind the firing line. The Engineers' Corps will carry its own rolling stock to the theater of war. This, in itself, will be a gigantic operation. An efficiency system has been worked out to provide against delay in loading and unloading which might interfere in any way with the maximum movement of the shipping available.

Car and Locomotive Orders in August

The orders for locomotives and cars reported in August totaled 781 and 12,460 respectively, practically all of this equipment being on orders placed by the United States Government for service with the troops in France. The totals follow:

	Locomotives	Freight cars
For United States Government	764	11,997
Domestic	12	463
Foreign	5	...
	781	12,460

The Government's orders for locomotives follow an order placed in July for 300 80-ton Consolidation locomotives, divided equally between the Baldwin Locomotive Works and the American Locomotive Company. The new order for 764 locomotives was given entirely to the Baldwin Locomotive Works and was as follows:

380	80 ton	Standard gage	Consolidation
195	.....	60 c m gage*	2-6-2
126	50 hp.	60 c m gage	Gasoline
63	30 hp.	60 c m gage	Gasoline

* 60 c m gage equals 1 ft. 11⅝ in.

The orders for cars included 6,000 standard gage cars, later increased to 9,000 by increasing each of the individual orders 50 per cent and 2,997 narrow (or 600 mm.) gage cars. The standard gage cars were divided as follows:

1,800	Low side gondola	Pressed Steel Car
1,500	Box	Am. Car & Fdy.
450	Tank	Am. Car & Fdy.
1,350	High side gondola	Standard Steel Car
1,200	Box	Standard Steel Car
900	Flat	Haskell & Barker
450	Refrigerator	Haskell & Barker
1,350	Box	Pullman

The narrow gage orders follow:

500	Flat	Pressed Steel Car
100	Trucks	Pressed Steel Car
166	Tank	Am. Car & Fdy.
700	Low side gondola	Am. Car & Fdy.
400	Low side gondola	Ralston Steel Car
400	Low side gondola	Magor Car
666	Box	Standard Steel Car
165	Gondola	Standard Steel Car

MEETINGS AND CONVENTIONS

The International Railroad Master Blacksmiths' Association.—Owing to the fact that an insufficient number of papers have been received by the secretary to justify the expense, the plan to publish the year book for 1917 has been abandoned. Announcement of the postponement of the convention was announced in the July, 1917, issue.

The Traveling Engineers' Association.—The executive committee of the Traveling Engineers' Association has decided that, owing to war conditions, the association will not hold its annual convention this year. The executive committee, however, will meet and will issue an annual report containing all information as to what has happened during the year. The committee reports and papers will be printed and new subjects will be sent out and committees appointed for next year's business.

Foundrymen's Convention.—The annual meeting of the American Foundrymen's Association and the American Institute of Metals will be held in the Mechanics' building, Boston, Mass., September 25 to 28, inclusive. The meeting

will be accompanied with its usual extensive exhibits, many of which will be of direct interest to railway men. The following are some of the subjects that will be discussed during the convention:

"Co-operative Shop Training," by W. B. Hunter, Fitchburg high school, Fitchburg, Mass.

"Improving the Relationship Between Employer and Employee," by J. F. Kent, American Cast Iron Pipe Company, Birmingham, Ala.

Report of A. F. A. committee on safety, sanitation and fire prevention, by Victor T. Noonan, chairman, Industrial Commission of Ohio, Columbus, Ohio.

Report of A. F. A. representatives on the conference board on training of apprentices, by Frank M. Leavitt, chairman, University of Illinois, Chicago.

"How Malleable Iron Has Improved," by Enrique Touceda, Albany, N. Y.

Report of A. F. A. committee on general specifications for gray iron castings, by W. P. Putnam, chairman, Detroit Testing Laboratory, Detroit, Mich.

"The Effect of High Sulphur in Gray Iron Castings," by T. Mauland, International Harvester Company, Chicago.

"The Use of Vanadium in Steel Castings," by J. Lloyd Uhler, Union Steel Castings Company, Pittsburgh, Pa.

"Casting Bearings in Sand and Metal Molds," by R. R. Clarke, Pennsylvania Lines West of Pittsburgh, Pittsburgh, Pa.

"Stellite," by Elwood Haynes, Haynes Stellite Works, Kokomo, Ind.

"The Use of Bronzes in Railroad Turntables and Movable Bridges," by O. E. Selby, Big Four Railroad, Cincinnati, Ohio.

"Analysis of Babbitts and Brasses," by E. W. Hagmaier, Buffalo, N. Y.

"The Flux and Cleaner Question of Brass," by E. D. Frohman, S. Obermayer Company, Pittsburgh, Pa.

Among the supply companies exhibiting, the following are interested in the railway supply field:

Ajax Metal Company, Philadelphia, Pa.
Armstrong Cork & Insulating Company, Pittsburgh, Pa.
Atkins & Company, E. C., Indianapolis, Ind.
Athol Machine Company, Athol, Mass.
Ayer & Lord Tie Company, Chicago.
Beaudry & Company, Inc., Boston, Mass.
Besley & Company, Charles H., Chicago.
Bullard Machine Tool Company, Bridgeport, Conn.
Carborundum Company, Niagara Falls, N. Y.
Chicago Pneumatic Tool Company, Chicago, Ill.
Cleveland Pneumatic Tool Company, Cleveland, Ohio.
Davis-Bournonville Company, Jersey City, N. J.
General Electric Company, Schenectady, N. Y.
Goldschmidt Thermit Company, New York.
Hauck Manufacturing Company, Brooklyn, N. Y.
Joseph Dixon Crucible Company, Jersey City, N. J.
Monarch Engineering & Manufacturing Company, Baltimore, Md.
Mahr Manufacturing Company, Minneapolis, Minn.
Osborn Manufacturing Company, Cleveland, Ohio.
Oxweld Acetylene Company, Jersey City, N. J.
Quigley Furnace Specialties Company, New York.
Sullivan Machinery Company, Chicago.
Titanium Alloy Manufacturing Company, Niagara Falls, N. Y.
United States Graphite Company, Saginaw, Mich.
United States Silica Company, Chicago.
Warner & Swasey Company, Cleveland, Ohio.
Whiting Foundry Equipment Company, Harvey, Ill.

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations:

Air Brake Association.—F. M. Nellis, Room 3014, 165 Broadway, New York City.

American Railroad Master Tinners', Coppersmiths' and Pipefitters' Association.—O. E. Schlink, 485 W. Fifth St., Peru, Ind. Convention postponed.

American Railway Master Mechanics' Association.—J. W. Taylor, Karpen Bldg., Chicago. Convention postponed.

American Railway Tool Foremen's Association.—R. D. Fletcher, Belt Railway, Chicago. Convention postponed.

American Society for Testing Materials.—Prof. E. Marburg, University of Pennsylvania, Philadelphia, Pa.

American Society of Mechanical Engineers.—Calvin W. Rice, 29 W. Thirty-ninth St., New York.

Association of Railway Electrical Engineers.—Joseph A. Andreucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago.

Car Foremen's Association of Chicago.—Aaron Kline, 841 Lawlor Ave., Chicago. Second Monday in month, except June, July and August, Hotel La Salle, Chicago.

Chief Interchange Car Inspectors' and Car Foremen's Association.—W. R. McMunn, New York Central, Albany, N. Y. Convention postponed.

International Railroad Master Blacksmiths' Association.—A. L. Woodworth, C. H. & D., Lima, Ohio. Convention postponed.

International Railway Fuel Association.—J. G. Crawford, 547 W. Jackson Blvd., Chicago.

International Railway General Foremen's Association.—William Hall, 1126 W. Broadway, Winona, Minn. Convention postponed.

Master Boilermakers' Association.—Harry D. Vought, 95 Liberty St., New York. Convention postponed.

Master Car Builders' Association.—J. W. Taylor, Karpen Bldg., Chicago. Convention postponed.

Master Car and Locomotive Painters' Association of U. S. and Canada.—A. P. Dane, B. & M., Reading, Mass. Convention postponed.

Niagara Frontier Car Men's Association.—E. N. Frankenberger, 623 Brisbane Bldg., Buffalo, N. Y. Meetings, third Wednesday in month, New York Telephone Bldg., Buffalo, N. Y.

Railway Storekeepers' Association.—J. P. Murphy, Box C, Collinwood, Ohio. Convention postponed.

Traveling Engineers' Association.—W. O. Thompson, N. Y. C. R. R., Cleveland, Ohio.

Personal Mention

GENERAL

J. W. Anderson, master mechanic of the West Iowa division of the Chicago & North Western at Boone, Iowa, has been appointed supervisor of motive power and machinery at Winona, Minn., succeeding W. E. Dunham, who has been promoted.

W. L. Bean, who has been acting as assistant to the president of the New York, New Haven & Hartford, has been appointed assistant to general mechanical superintendent.

Karl Berg, chief draftsman of the mechanical drawing room of the Pittsburgh & Lake Erie has been promoted to mechanical engineer, succeeding W. P. Richardson, resigned. Mr. Berg was born in Sweden on December 30, 1881. He studied at the Carnegie Institute of Technology and entered the service of the Pittsburgh & Lake Erie in June, 1903, as helper in the machine shop. In June, 1904, he began a machine shop apprenticeship and was transferred to the mechanical drawing room in June, 1908. In November, 1909, he resigned and secured a position as draftsman with the H. K. Porter Company of Pittsburgh, Pa., but in July, 1911, re-entered the employ of the Pittsburgh & Lake Erie as draftsman. On January 1, 1917, he was promoted to chief draftsman of the mechanical drawing room, following which he was appointed mechanical engineer.

W. H. Bradley, master mechanic of the Chicago & North Western at Clinton, Ia., has been appointed assistant to the general superintendent of motive power, with headquarters at Chicago, Ill., succeeding E. C. Hall.

H. B. Brown, general fuel inspector of the Illinois Central at Chicago, has been appointed superintendent of the fuel department of the Lehigh Valley at South Bethlehem, Pa.

Walter E. Dunham, supervisor of motive power and machinery of the Chicago & North Western at Winona, Minn., has been appointed assistant to the general superintendent of the motive power and car departments, with headquarters at Chicago. Mr. Dunham was born in Newark, N. J., on September 9, 1873. He graduated from Cornell University in 1895 as a mechanical engineer and entered railroad service in October, 1896, as a helper in the shops of the Chicago, Rock Island & Pacific at Horton, Kan. In 1898 he became a draftsman in the Chicago office and in 1900 was appointed master mechanic at Dallas, Tex. In 1902 he went with the Chicago & North Western as chief draftsman at Chicago and was promoted to mechanical engineer in 1903. In 1906 he was appointed master mechanic of the Minnesota and Dakota divisions with headquarters at Winona, Minn., and in 1910 was made supervisor of motive power and machinery.

W. E. Dunham

H. A. EMPIE has been appointed general fuel agent of the Delaware & Hudson. His headquarters will be at Albany, N. Y.

G. O. HAMMOND, assistant general mechanical superintendent of the New York, New Haven & Hartford, has been appointed general mechanical superintendent, succeeding G. W. Wildin, promoted.

WILLIAM NELSON has been appointed mechanical engineer of the Minneapolis, St. Paul & Saul Ste. Marie, succeeding H. C. Bayless, resigned.

JOHN J. HANLIN, whose appointment as assistant superintendent of motive power of the Seaboard Air Line with headquarters at Portsmouth, Va., was announced in these columns last month, was born on June 1, 1871, in Texas county, Missouri. He was educated in the common schools and in 1888 became an apprentice at the Birmingham Foundry & Machine Company, and four years later, on the completion of his apprenticeship, became a machinist on the Louisville & Nashville, remaining in that position until 1900. He was then appointed general foreman of the Birmingham Southern at Birmingham, Ala., and in 1904 became general foreman on the Seaboard Air Line at the same place. In 1907 he was appointed master mechanic at Atlanta, Ga., which position he held until his recent appointment as assistant superintendent of motive power.

J. J. Hanlin

J. T. WALLIS, general superintendent of motive power of the Pennsylvania Railroad at Altoona, Pa., has had his authority extended over the New York, Philadelphia & Norfolk.

GEORGE W. WILDIN, general mechanical superintendent of the New York, New Haven & Hartford on September 1, was appointed general manager of that company, succeeding C. L. Bardo who has been promoted to the position of assistant to the president. Mr. Wildin has been in the service of the New Haven since July, 1907. He was born at Decatur, Ill., February 28, 1870, and graduated from the Kansas State Agricultural college with the degree of bachelor of science in June, 1892. He entered railway service shortly afterwards as a mechanical draftsman in the Topeka shops of the Atchison, Topeka & Santa Fe. He subsequently became a machinist and locomotive fireman on the Santa Fe and later an engineman on the Mexican Central. Leaving railway service he was for a while superintendent of the Aermotor Company, Chicago. He returned to railway service shortly, however, as an engineman on the Chicago & Alton and then went to the Plant System, now a part of the Atlantic Coast Line where he served successively as a machinist, a locomotive and car inspector and as mechanical engineer. From April 1, 1901, to March 1, 1904, he was mechanical engineer of the Central of New Jersey. On March 1, 1904, he left that company to become assistant mechanical superintendent of the Erie, being promoted on April 1 of the same year to mechanical superintendent at Meadville. From January to July, 1907, he served as assistant superintendent of motive power of the Lehigh Valley and then left that road to accept a position as mechanical superintendent of the New Haven. In May, 1917, he was promoted to general mechanical superintendent. Mr. Wildin was president of the American Railway Master Mechanics' Association in 1910.

G. W. Wildin

C. D. YOUNG, superintendent of motive power of the Philadelphia, Baltimore & Washington, at Wilmington, Del., now also has authority over the New York, Philadelphia & Norfolk.

W. D. ROBB has been appointed vice-president of the Grand Trunk, in charge of motive power, car equipment and machinery, with headquarters at Montreal, Que. Mr. Robb was born at Longueuille, Que., on September 23, 1857. He received his early education in Sherbrooke Academy and St. Francis College, Richmond, Que., entering the service of the Grand Trunk Railway System as an apprentice at Hadlow Cove, July 1, 1871. In 1873 he was transferred to Montreal where he finished his apprenticeship as a machinist. In February, 1883, he was appointed night foreman at Point St. Charles shops and in August of the same year he was promoted to the position of foreman at Belleville in charge of the motive power and car department. He became master mechanic of the Middle division, with headquarters at London, Ont., in January, 1897, and was appointed acting superintendent of motive power at Montreal in July, 1901. In May, 1902, he received his appointment as superintendent of motive power, which position he has since occupied continuously until his recent appointment as vice-president.

W. D. Robb

MASTER MECHANICS AND ROAD FOREMEN OF ENGINES

L. CHAPMAN, division master mechanic of the Chicago & North Western at Belle Plaine, Iowa, has been transferred to the West Iowa division, with headquarters at Boone, succeeding J. W. Anderson.

C. GRIBBIN has been appointed master mechanic of the Canadian Pacific, with office at North Bay, Ont., succeeding T. Hambley.

T. HAMBLEY, acting master mechanic of the Canadian Pacific at North Bay, Ont., has been appointed division master mechanic, with headquarters at Sudbury, Ont., succeeding W. Wells.

HEBER L. HARVEY, road foreman of engines on the Wisconsin division of the Chicago & North Western, has been appointed master mechanic of the Iowa and Minnesota division, with headquarters at Belle Plaine, Iowa. Mr. Harvey was born at Amherst, Wis., on July 9, 1874, and was educated in the public schools. He commenced railway work on September 11, 1899, as a fireman on the Galena division of the Chicago & North Western. In May, 1903, he was promoted to engineer, in January, 1907, to traveling fireman and in 1909 to assistant road foreman of engines. He was advanced to road foreman of engines on the Wisconsin division in April, 1912, his headquarters having been at Chicago.

M. P. HOBAN, road foreman of engines of the Cincinnati, Hamilton & Dayton, at Dayton, Ohio, is now road foreman of engines of the Toledo division of the Baltimore & Ohio, with office at the same place. The Baltimore & Ohio recently acquired the principal lines of the Cincinnati, Hamilton & Dayton and is now operating them as the Toledo division of the Northwest district.

ANDREW H. BEIRNE, whose appointment as master mechanic of the Western division of the Atchison, Topeka & Santa Fe at Dodge City, Kansas, was announced in the *Railway Mechanical Engineer* last month, was born on February 16, 1879, at Oroville, Cal., and was educated in the public schools of Lewisburg, W. Va. He entered the employ of the Atchison, Topeka & Santa Fe as a machinist at San Bernardino, Cal., in October, 1904, having previously been employed in that capacity by several industrial concerns. In June, 1906, he became a machinist for the Colorado & South Eastern at Hastings, Colo., but in August, 1906, returned to the Atchison, Topeka & Santa Fe as a machinist and was thereafter promoted to machine foreman, gang foreman, roundhouse foreman, general foreman and division foreman at various points on the Western lines until his recent appointment as master mechanic of the Western division.

A. H. Bierne

J. W. JACKSON, locomotive foreman of the Canadian Pacific at Kamloops, B. C., has been appointed acting division master mechanic of the Cranbrook division, British Columbia district, with office at Cranbrook, B. C., succeeding W. H. Wortman, transferred.

W. D. JOHNSTON, master mechanic of the Cincinnati, Hamilton & Dayton, at Dayton, Ohio, has been appointed master mechanic of the Toledo division of the Northwest district, of the Baltimore & Ohio, with headquarters at the same place.

E. LINDSAY has been appointed assistant master mechanic of the Atlantic, Quebec & Western at New Carlisle, Que.

WILLIAM R. MEEDER, whose appointment as master mechanic of the Illinois Southern, with office at Sparta, Ill., was announced in these columns last month, was born in Maries county, Mo., on January 20, 1874, and was educated in the public schools. In September, 1891, he entered the employ of the Chicago, Rock Island & Pacific and in 1901 became roundhouse foreman of the Illinois Central at the Burnside shops in Chicago. In 1904 he went to the Chicago & Eastern Illinois as general foreman at Dalton, Ill., and from February, 1913, to January, 1917, was master mechanic, his headquarters having latterly been at Villa Grove, Ill.

A. L. MOLER has been appointed master mechanic of the Saratoga and Champlain divisions of the Delaware & Hudson, with office at Colonie, N. Y., succeeding J. H. Stranahan, transferred.

T. M. PRICE, general foreman of the Seaboard Air Line shops at Portsmouth, Va., has been appointed assistant master mechanic at Andrews, S. C., succeeding J. W. Watson, promoted.

T. L. REED, master mechanic of the Seaboard Air Line at Hamlet, N. C., has been appointed master mechanic of the Georgia division, with headquarters at Howells, Ga.

O. R. STEVENS, road foreman of engines of the Cincinnati, Hamilton & Dayton, at Lima, Ohio, is now road foreman of engines of the Toledo division of the Northwest district of the Baltimore & Ohio, with headquarters at the same place.

J. W. WATSON, assistant master mechanic of the Seaboard Air Line at Andrews, S. C., has been promoted to master mechanic, with office at Hamlet, N. C.

A. D. WILLIAMS, master mechanic of the Southern Pacific at Stockton, Cal., has been appointed superintendent of motive power of the Northern district, with headquarters at Sacramento, succeeding D. P. Kellogg, resigned to accept service with another company.

W. WELLS, division master mechanic on the Algoma district of the Canadian Pacific at Sudbury, Ont., has been appointed division master mechanic, with office at Schreiber, Ont., succeeding F. Grant, transferred.

SHOP AND ENGINEHOUSE

A. FULLER has been appointed a foreman at the West Albany shops of the New York Central, succeeding D. Brewer, resigned.

SAMUEL R. PARSLOW, whose appointment as shop superintendent of the Great Northern at Great Falls, Mont., was announced in the August issue of the *Railway Mechanical Engineer*, was born in Canada on February 22, 1872, and received his education in the public schools. He served a brass finishing apprenticeship with the J. T. Morrison Brass Manufacturing Company of Toronto, Ont., and entered railway service in 1897 with the Canadian Pacific at Winnipeg, Man. In April, 1900, he went to the Great Northern as brass finisher at the Jackson street shops. In July, 1903, he was promoted to assistant machine foreman and in 1906 to machine foreman of the Dale street shops. In 1915 he was appointed valuation inspector of shop tools and machinery, which position he held

S. R. Parslow

at the time of his recent appointment as shop superintendent.

J. E. GILES has been appointed locomotive foreman of the Canadian Northern at Lucerne, B. C., succeeding F. G. Flesher, resigned.

R. HOEY, formerly general boiler inspector at the West Albany shops of the New York Central, has been promoted to assistant boiler foreman.

E. IVERSON, formerly machine shop foreman of the West Albany shops of the New York Central, has been appointed assistant general foreman of shops, succeeding E. Kennedy, resigned.

JOSEPH MCALLESTER, formerly boiler foreman of the West Albany shops of the New York Central, has been promoted to general foreman of shops, succeeding E. Williams, resigned.

B. REESE, formerly assistant machine shop foreman of the New York Central at West Albany, N. Y., has been promoted to machine shop foreman.

W. SMALL, acting shop foreman of the Canadian Pacific at Revelstoke, B. C., has been appointed locomotive foreman at Kamloops, B. C., succeeding J. W. Jackson, who has been promoted.

A. L. SPROULE has been appointed locomotive foreman of the Canadian Northern at Neepawa, Man., succeeding W. Gibb, transferred.

G. R. STEEVES has been appointed locomotive foreman of the Canadian Northern at Hanna, Sask., succeeding A. T. Hannah, who has left the service.

A. STEYLMEIER, formerly assistant boiler foreman at the West Albany shops of the New York Central, has been promoted to the position of general foreman boilermaker at that point.

CAR DEPARTMENT

W. J. AMOR has been appointed superintendent of car shops and yards of the Western lines, Canadian Government Railways, with office at Transcona, Man., succeeding J. L. Hodgson, general car foreman, deceased.

R. W. BURNETT has been appointed master car builder of the Delaware & Hudson, with office at Albany, N.Y. Mr. Burnett was born at Farmer City, Ill., in 1868 and in 1890 entered the service of the Union Pacific in the car department at Denver, Colo. In 1892 he was connected with the Pennsylvania Railroad at Chicago as a car inspector, and from August, 1892, to July, 1899, was with the Lake Shore & Michigan Southern at Chicago as a foreman and general foreman of the car department at Englewood. The early part of 1900 he spent as general foreman of the car department of the Long Island, going in the latter part of the year to the Central of New Jersey at Elizabethport, N. J., as general foreman of the car department. He remained with that road about five years, and in 1904 went with the Erie, and was connected with it in the capacities of assistant master car builder and master car builder, with headquarters at Meadville, Pa., until January, 1907. He left the service of the Erie to go with the Canadian Pacific as assistant master car builder, and in 1909 was promoted to general master car builder. In 1913 he was also elected vice-president of the Master Car Builders' Association. In November, 1915, he left the service of the Canadian Pacific and has since been vice-president of the National Car Equipment Company, Chicago, from which position he now returns to railroad service.

R. W. Burnett

R. CROSBY, car inspector of the Canadian Northern at Blue River, Sask., has been appointed car foreman at Moose Jaw, Sask.

A. LYDON, car inspector of the Canadian Northern at Prince Albert, Sask., has been appointed car foreman at Radville, Sask.

W. THOMAS has been appointed car foreman of the Canadian Pacific at White River, Ont., succeeding J. Flynn, transferred.

PURCHASING AND STOREKEEPING

W. D. STEWART has been appointed general storekeeper of the Western lines of the Canadian Government Railways with office at Transcona, Man.

NEW SHOPS

SOUTHERN RAILWAY.—This company is building an 18-stall steel reinforced concrete roundhouse at Greensboro, N. C., with the necessary shops and a modern five-track coal chute. The road is increasing its yard facilities at the same point.

NEVADA-CALIFORNIA-OREGON.—This road is erecting an administration building, a roundhouse, a machine shop and other minor buildings at Alturas, Cal., the cost of which, including real estate and necessary trackage, will aggregate about $75,000.

NEW YORK, NEW HAVEN & HARTFORD.—Company forces are now at work on a new 18-stall brick, concrete and hollow tile roundhouse at Cedar Hill yard just east of New Haven. The roundhouse will be about 98 ft. wide, 488 ft. long, and will cost about $141,000.

GRAND TRUNK.—A contract has been awarded by this company to James Stewart & Co., New York, for the construction of a car repair shop at Port Huron, Mich. The building will be 22 ft. high, 77 ft. wide and 360 ft. long, with brick walls, concrete foundation, and a tar and gravel roof.

ATCHISON, TOPEKA & SANTA FE.—This company has awarded a contract to the Cresmer Manufacturing Company, Riverside, Cal., for the erection of buildings at its car shops at San Bernardino, including a one-story refrigerator car repair shed, 46 by 1,200 ft.; a one-story blacksmith shop, 50 by 385 ft., and a one-story car repair shop, 46 by 310 ft. The cost of these improvements will approximate $60,000.

SEABOARD AIR LINE.—Contracts have been let by this company for building a coach and truck shop and for an upholstery building at Portsmouth, Va. These two buildings are to replace the coach shop destroyed by fire. The new coach and truck shop will be 92 ft. wide by 248 ft. 6 in. long, divided in two parts by a brick fire wall. The upholstery building will be 32 ft. wide by 92 ft. long. Both buildings are of the same construction and will have concrete foundations with a concrete wall 4 ft. above the floor. The structures will be wood frame with 2½-in. Hy-rib siding and will be equipped with steel rolling doors. The truck shop will have overhead crane service.

SUPPLY TRADE NOTES

The Railway Specialties Corporation has moved its office to larger quarters at 30 Church street, New York.

Howard C. Mull, sales representative of the Verona Tool Works in the Chicago office, has been appointed sales agent in charge of the Chicago territory.

P. M. Kling, consulting engineer of the Laconia Car Company, Laconia, N. H., has resigned. Mr. Kling retires, after having spent 34 years in the car industry.

The Hazard Manufacturing Company, Wilkesbarre, Pa., announces the appointment of George B. North as general sales manager, with headquarters at New York.

William H. Ross has become associated with the Patton Paint Company, Milwaukee, Wis., and will represent the railway sales department as sales engineer, with headquarters at Pittsburgh, Pa.

W. S. Spieth has been appointed manager of the Davis wheel department of the American Steel Foundries, with office at Chicago, to succeed F. A. Lorenz, Jr., who has resigned to go into other business.

R. G. Taylor, sales representative for the American Car & Foundry Company, has been commissioned captain of ordnance in the Officers' Reserve Corps, and has been assigned to duty at Rock Island, Ill.

William L. Allison, vice-president of the American Arch Company, Chicago, who has been training at the officers' training camp at Ft. Sheridan, Ill., has been commissioned a major in the Officers' Reserve Corps.

Thomas H. Garland, president of the Garland Ventilation Company, Chicago, and inventor of the Garland car ventilator, died in Chicago on August 20, following a protracted illness. Mr. Garland was 56 years old.

On August 1 the Kewanee plant of the National Tube Company, located at Kewanee, Ill., was sold to the Walworth Manufacturing Company, Boston, Mass., and on that date the National Tube Company retired from the fittings business.

Edwin T. Jackman of E. S. Jackman & Co., Chicago, Cleveland and Pittsburgh, agents for the Firth-Sterling Steel Company, has received an appointment as first lieutenant in the Ordnance Section of the Officers' Reserve Corps, and is now on active duty.

The Lipman Refrigerator Car & Manufacturing Company, Beloit, Wis., has commenced the construction of a foundry, tank and welding shops and an office building in that city, and will soon commence work on car sheds and other buildings. The initial expenditure will be about $50,000.

F. R. Cooper, formerly superintendent of motive power of the Kansas City Southern, and until recently connected with the Breakless Staybolt Company of Pittsburgh, Pa., has resigned from the latter company to become sales manager of the Gold Car Heating & Lighting Company, with offices at New York.

McCord & Co. have purchased three and one-half acres of land at West Pullman, Ill., from the Illinois Central. This property has been occupied by the purchasers for the last two years under a lease from the Illinois Central, with the option of purchase. A part of the property is improved with a plant which has been used as a steel foundry for the manufacture of journal boxes.

Arthur S. Lewis has resigned his position with the Chicago-Cleveland Car Roofing Company to join the sales force of Flint & Chester, Inc., New York. Mr. Lewis as assistant to the president will have charge of sales to railroads and other large corporations. He succeeded W. B. Wise, resigned to go into other business.

The Acar Manufacturing Company, 30 Church street, New York, manufacturers of the blue signal safety device, announces the appointment of Leland T. Johnson as special representative, with headquarters at the Hotel Sherman, Chicago, and Burt E. Dana, New York salesman, with headquarters at 30 Church street, New York.

Edward C. Fisher, manager of the Cooke Works of the American Locomotive Company since September 26, 1916, has been transferred from Paterson, N. J., to become manager of the American Locomotive Company's plant at Pittsburgh, Pa. A sketch and photograph of Mr. Fisher appeared in the *Railway Mechanical Engineer* of October, 1916, p. 547.

Adrian D. Joyce, general manager of sales and distribution of the Sherwin-Williams Company, has been appointed by the Federal War Industries Board to membership on a special committee for the standardization of paints and varnishes in connection with war purchases. On the committee with Mr. Joyce are six other prominent paint manufacturers of the country.

A. E. Heffelfinger, who for more than two years past has been chief draftsman of the National Steel Car Company, Ltd., Hamilton, Ont., has recently been appointed chief engineer of that company. Mr. Heffelfinger was born April 10, 1881, at Reading, Pa. Following his graduation from the Williamson Free School of Mechanical Trades in 1900 he entered railroad service as a special apprentice in the car shops of the Philadelphia & Reading, at Reading, Pa. On the completion of his apprenticeship he became respectively draftsman, designer, checker, estimator, computer and principal assistant engineer with the Harlan & Hollingsworth Corporation, the Pressed Steel Car Company and the American Car & Foundry Company. He was with the latter company for over eight years, during which time his headquarters were in its New York office. Mr. Heffelfinger has had a wide experience in handling engineering problems in connection with the manufacture of railroad equipment for export use and he served as engineer to the Cuban representative of the American Car & Foundry Company in 1912 and 1913. Mr. Heffelfinger will be remembered by the readers of the *American Engineer* for several articles which he contributed to its columns, dealing with practical problems of car design, during the past eight years.

A. E. Heffelfinger

Jesse Hough, sales representative of the National Lock Washer Company, died at his home in Indianapolis, Ind., on July 23, after a seven months' illness. Mr. Hough had been associated with the National Lock Washer Company since January, 1913, and for 10 years prior to that time was

storekeeper in the maintenance of way department of the Indianapolis Traction & Terminal Company.

The American Car & Foundry Company has leased for five years a half of the 17th floor of the Hudson Terminal building, 30 Church street, New York, and will consolidate its New York and St. Louis offices there. At present the company has New York offices at 165 Broadway, but could not obtain sufficient space in that building to provide for the departments that will be moved to New York from St. Louis.

The Ingersoll-Rand Company announces that at a meeting of the board of directors of the company, on July 25, J. H. Jowett, formerly general sales manager, was elected vice-president of the company, and that L. D. Albin, formerly assistant general sales manager, was appointed general sales manager. Mr. Jowett and Mr. Albin will continue to make the company's New York office at 11 Broadway, their headquarters.

F. P. Huntley, after having completed 28 years of continuous service with the Gould Coupler Company and allied interests, has resigned as vice-president and general manager of that company and the Gould Storage Battery Company. Mr. Huntley began his business career in 1888, when he became a stenographer to the superintendent of motive power of the New York, Lake Erie & Western (now part of the Erie), but very shortly afterward he left to become associated with the Gould interests as a bookkeeper and stenographer in the Gould Steam Forge, which completed an axle plant at Buffalo, New York, early in 1889. It is interesting to know that 21 years later (in 1909) Mr. Huntley introduced the first quick-acting hydraulic press used in this country in this same forge plant, then located at Depew, N. Y. The Gould Coupler Company started in business in 1889, but its manufacturing was done for some years under contract by outside plants. In 1892 the main office of the company was moved to New York City, and the malleable iron plant was built at Depew. Mr. Huntley was made secretary and director of the Gould Coupler Company in 1892, this company having previously absorbed the Gould Steam Forge. Seven years later, in 1900, when the Gould Storage Battery Company was formed, he was elected vice-president and a director of that company, holding that position continuously thereafter. In 1903 the plant for the manufacture of larger steel castings was erected at Depew, in which bolsters, couplers, side frames, and miscellaneous railroad castings were made. Both the erection of this plant and its operation afterward was under the direct charge of Mr. Huntley. In 1905 Mr. Huntley resigned as secretary of the Coupler Company and was elected vice-president, general manager, and a director, which position he now relinquishes. Mr. Huntley, still a young man, has had the opportunity of seeing and studying from their inception, most of the modern devices now used in railroad service in this country, and to a certain extent abroad. It is probable that he will continue to be identified with the railway supply industry, although as yet he has announced no plans.

F. P. Huntley

The International Oxygen Company announces the appointment of R. M. Klein as sales manager, with headquarters at the company's main office, 115 Broadway, New York. Mr. Klein was formerly an engineer in United States government employ. He later served as salesman and sales manager for the Diehl Manufacturing Company, and as manufacturers' representative handling a number of mechanical lines. He entered upon his new duties July 1.

The Walter A. Zelnicker Supply Company, St. Louis, Mo., has recently secured the services of J. C. Bryan, formerly with Manning, Maxwell & Moore, Inc., as that company's southwestern representative of the Ashcroft Manufacturing Company, the Consolidated Safety Valve Company, the Hayden & Derby Manufacturing Company, and the Hancock Inspirator Company. Mr. Bryan will be associated with the equipment department of the Zelnicker company.

The Western Electric Company announces the opening of three new electrical supply warehouses, one in New Haven, Conn., at 135 Wood street, in charge of Tyler L. Holmes; a second at 425 East Oliver street, Baltimore, Md., in charge of S. Greenfield, and the third in Charlotte, N. C., at 238 West First street, in charge of R. H. Bouligny. In order to take care of the growing demands of the business in the Northwest adequately, the warehouse and sales office of the Western Electric Company have been moved into new and commodious quarters at 84 Marion street. W. H. Quirk at Cincinnati, Ohio. W. L. Sioussat will succeed Mr. Quick has been appointed manager of the Western Electric house as stores manager in the company's Cleveland house.

American Locomotive Company

If there is one thing in the recently issued annual report of the American Locomotive Company that shows what has been going on in the equipment market in the last few months, it is the statement that the total unfilled orders on June 30, 1917, amounted to $77,620,449, as compared with $19,376,532 on June 30, 1916. The gross earnings of the company in the fiscal year ended June 30, 1917, were $82,000,000, as against $59,000,000 in 1916. The increased cost of operation, however, was such that the profits on the year's business were only $7,000,000, as compared with nearly $11,000,000 in 1916.

Chairman Sylvanus L. Schoonmaker in his annual report to the stockholders of the company, says in part:

"During the year prices of materials of all kinds increased to an unprecedented degree; a great scarcity of both skilled and unskilled labor existed, notwithstanding that large increases in wages were made and the working time of the shops shortened. These abnormal operating conditions, which could not be fully anticipated, affected the profits on both locomotives and munitions.

"As a part of the plan of restoring the Richmond plant, and with the purpose of obtaining an immediate increase in the foundry capacity of that plant for locomotive work, the company purchased on June 25, 1917, the land and buildings of the Henrico Iron Works Corporation at Richmond, Va., suitable, with improvements which can be quickly installed, for making locomotive gray iron castings.

"It is the purpose of the management to manufacture as much of the material entering in large quantities into the construction of locomotives, as can be produced by the company to economic advantage. In accordance with this policy, the company purchased on July 2, 1917, from the Penn Seaboard Steel Corporation, a modern steel casting plant at Chester, Pa., known as the Seaboard Works. As a part of the terms of purchase your company acquired the full working organization of the Seaboard plant, which has continued to operate without cessation, and its entire output is now being used for the company's locomotive work."

CATALOGUES

VISES.—The Western Tool & Manufacturing Company, Springfield, Ohio, has recently issued a booklet descriptive of the company's Champion vises.

LATHES.—An attractive eight-page booklet recently issued by the Gisholt Machine Company, Madison, Wis., gives a number of illustrations of Gisholt lathes and time studies of various kinds of work turned out on them. The booklet contains a striking cover bearing the inscription: "Old Glory and the Allies," and showing the flags of all nations now waging war on Germany.

PNEUMATIC PAINTING EQUIPMENT.—The Spray Engineering Company, 93 Federal street, Boston, Mass., has recently issued a folder describing its equipment for applying all kinds of liquid coatings with the Spraco paint gun. Particular attention is called to an extension pole attachment made up of a jointed fiber rod, which is used for covering surfaces beyond the reach of the operator, thus eliminating the necessity for staging or ladders.

CRANES.—Catalogue No. 130, recently issued by the Whiting Foundry Equipment Company, Harvey, Ill., is an attractive and well illustrated book, 8½ in. by 11 in. in size, descriptive of the line of Whiting cranes. The catalogue gives illustrations and descriptions of a large number of cranes of different types, and shows views of typical installations. Many of the cranes given are for special use on railroads, as, for example, at ash pits, for transfer service, for handling freight and in locomotive shops.

EDISON STORAGE BATTERIES FOR USE IN STORAGE BATTERY LOCOMOTIVES is the title of bulletin 608 of the Edison Storage Battery Company, Orange, N. J. This bulletin, which is just off the press, describes the use of Edison storage battery locomotives in coal mining, metal mining and in general industrial service. The bulletin is full of photographs of locomotives in actual service, and there are two pages which contain complete general data and trade dimensions of Edison Type A storage batteries for storage battery locomotives.

DROP FORGINGS.—J. H. William & Co., Brooklyn, New York, has distributed the sixteenth issue of its catalogue describing the iron, steel, copper, bronze and aluminum drop forgings made by that company. In addition to its regular catalogue, one printed in Russian has been published for the trade in that country. These catalogues contain descriptions with special illustrations and list prices of various types of drop forge wrenches, tool holders, lathe dogs, clamps, gages, eye bolts, hooks, crank shafts, etc. Both catalogues are well illustrated.

PNEUMATIC TOOLS.—The Ingersoll-Rand Company, New York, has issued two new catalogues as follows: Form 3311, covering Imperial Type X Duplex steam-driven compressors suitable for general industrial application of compressed air. The catalogue gives tables of sizes and capacities, and is thoroughly illustrated to show the machine in detail. Form 8507 covers Little David pneumatic drills. A large number of various types and models are shown with recommendations as to the particular character of work for which they are adapted. Each tool is illustrated, and the several tables give the sizes and capacity of each tool.

AUTOMATIC CUT-OFF VALVES.—Catalogue N-4, issued by the Lagonda Manufacturing Company, Springfield, Ohio, describes in detail the different classes of Lagonda automatic valves, showing these valves arranged for installation in different positions. Sectional views are shown of four classes of valves, and full information regarding the operation of the valves is given, as well as dimensions and specifications. A number of installations of Lagonda valves are illustrated. A discussion of the need of automatic valves is given by way of introduction, featuring recommendations of insurance companies and U. S. government tests on Lagonda valves.

TEXACO AT HOME AND ABROAD.—The Texas Company has issued a very attractive 48-page booklet, 9 in. by 12 in. in size, telling about the Texas Company, what it does and where and with what efficiency its products are used. In the book, according to its preface, the company has "endeavored to sketch lightly with pen and pencil some of the interesting items about our business." Each page is devoted to an interesting phase of the company's business, some of them dealing, for example, with gathering the oil, transporting the oil, the refinery, Texaco in Panama, selling to the railroads, the dreadnoughts, the fastest boat in the world, Texaco products in distant China, etc. Each page is illustrated with a neat sketch showing an appropriate scene.

ACORN DIES AND HOLDERS.—The Greenfield Tap & Die Corporation, Greenfield, Mass., has recently issued an illustrated booklet describing its Acorn dies and die holders. The Acorn die is adjusted radially by means of an internal cone adjusting cap, which fits over the ends of the die lands. This makes possible accuracy of adjustment without interfering with the lead. The die is easily sharpened by grinding and when once set up may be removed and replaced or reground without disturbing the position of the holder in the machine. The catalogue contains illustrations showing clearly the construction of the Acorn die, the releasing die-holder and adapter for applying the Acorn die to machines or holders already in operation. The holders are hollow and there is no limit to the length of thread which they will cut. The booklet contains the usual catalogue information as to prices and specifications.

A NEW IDEA IN TWIST DRILL CATALOGUES.—The Cleveland Twist Drill Company, Cleveland, Ohio, has incorporated in its newest twist drill catalogue, No. 39, a thumb index and various other features which will distinguish it from the usual twist drill catalogue. The thumb index will enable the drill user to locate any one of the ten sub-divisions, and each index is supplemented further by a detailed index of the particular section. Each of the sections is also prefaced by an illustration graphically portraying some item in the manufacture of Cleveland tools or some unusual sales point in one of these tools. All the regular tools are shown and some of the special tools, but for the sake of brevity a number of other special tools are omitted. The book also has another good feature in that the prices of high speed tools are shown in red, thus making it easier to distinguish the lists of high speed and carbon steel tools.

GRINDING AND POLISHING MACHINERY.—A 120-page catalogue has just been issued by the Gardner Machine Company, Beloit, Wis., describing its line of grinding machines, abrasive material and accessories. The catalogue is a 7 in. by 10 in. book, bound in heavy paper board and printed on an excellent quality of coated paper. The catalogue contains an introduction dealing in a general way with the features of design of the Gardner line and several pages of valuable information for the user of grinding wheels and materials. The body of the catalogue contains descriptions of the various machines and accessories, well illustrated, together with illustrations of numerous installations in actual service. The usual information as to prices, specifications and code words are contained in tables at the back of the book. The machines illustrated include disk grinders for metal, disk grinders for the pattern shop, ring wheel grinders, band finishing machines, polishing and buffing lathes, ring wheel chucks, fixtures for disk grinders, abrasive disks, cloth and paper, and other accessories.